COMPTON'S

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AND

FACT-INDEX

INTERESTING · ACCURATE · UP-TO-DATE

To inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, and thus lead into broader fields of knowledge—such is the purpose of this work

VOLUME 4

F. E. COMPTON & COMPANY · CHICAGO

Here and There in This Volume

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit far-away countries and watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Reference-Outlines.

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Parent and Child; School and Home

High Lights in History's Pageant

Travel-Views at Home and Abroad

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In the Plant and Animal World

Marvels of Science and Invention

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HERE AND THERE IN THIS VOLUME

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Key to Pronunciation

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index. Marked letters are sounded as in the following words: *cāpe, ăt, fär, fȧst, what, fall; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, do; cūre, bŭt, rude, full, bûrn; ü* = French *u*, German *ü; ġem, ḡo; thin, then; ṅ* = French nasal (*Jeaṅ*); *zh* = French *j* (*z* in *azure*); κ = German guttural *ch*.

D

DAEDALUS (*dĕd′ȧ-lŭs*). This fabled Athenian inventor and craftsman was the first man to fly, according to Greek myth. He had been forced to leave Athens and took refuge in Crete, which was ruled by King Minos. There he built the famous Labyrinth for the man-bull, the Minotaur (*see* Theseus). Soon after its completion Daedalus incurred the anger of King Minos, and he and his son Icarus were imprisoned in its mazes. Daedalus made wings of feathers and wax with which they escaped. Daedalus flew safely over the Aegean Sea to Sicily. But when Icarus, despite his father's warnings, flew too near the sun, the wax of his wings melted, and he fell into the sea. Daedalus was said to be the inventor of the saw and other tools.

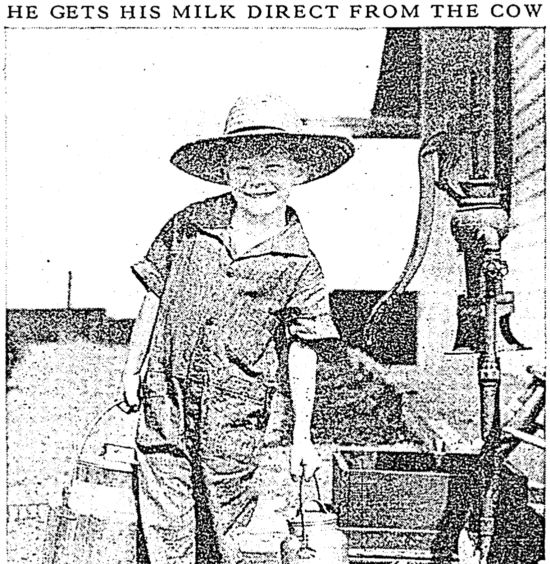
DAHLIA (*dăl′yȧ*). In the gardens of the Aztecs bloomed the first cultivated dahlias, which are native to the high tablelands of Mexico and Guatemala. Dahlias were introduced into Europe in 1789, and named in honor of Andreas Dahl, a Swedish botanist.

The parent wild flower is flat, with a yellow center and single scarlet rays. Modern varieties may be double and globular in shape. They are from 18 inches to 12 or more feet high, and they range in color from white through shades of yellow, orange, red, and purple.

Dahlias bloom, according to variety, from June to November. They will thrive in any well-drained garden soil, but must be protected from wind. They may be propagated from seed or cuttings, by grafting to perpetuate rare varieties, or by division of the tuberous roots. The last method is most common with amateur gardeners. Growing from seed produces many interesting varieties, as the seedlings do not accurately reproduce the characteristics of the parents. When frost has killed the tops, the roots should be dried and stored in a cool cellar, to be replanted early in the spring.

The dahlia forms a genus of the family *Compositae*. The nomenclature of the species is confused because they so closely resemble one another. *Dahlia variabilis*, also known as *D. rosea*, is the parent of the great majority of modern varieties. *Dahlia Juarezii* is the parent of the important group of cactus dahlias. The American Dahlia Society classifies the varieties, of which there are thousands, as follows: single, orchid-flowering, anemone, collarette, peony, star, incurved cactus, straight cactus, semi-cactus, formal decorative, informal decorative, ball, miniature, and pompon.

HE GETS HIS MILK DIRECT FROM THE COW



This farm boy does not have to wait for the milkman in the morning. But the millions of city children depend for their milk on the huge and complicated dairy industry.

DAIRYING. Every day in the year, long before you are awake, the milk wagons are rolling through the streets, bringing city people the milk for their morning oatmeal and cream for coffee. Did you ever think of the many persons who contribute to bring this about? If you follow the back-trail of the milkman, you come first to the bottling plant. There the milk is pasteurized and bottled for distribution. It is brought to the plant in great tank cars or motor trucks from the country receiving stations. The tanks are made of stainless steel or lined with glass, and insulated to keep the milk at the right temperature. Some milk is still shipped in cans, in the old-fashioned way. At the country receiving station, you see the farmers' milk being weighed and tested. From the receiving station the wide tracks of a motor truck lead you over a country road to a big dairy barn. There the farmer will show you the source of your milk—a herd of cows. (For pictures of these various steps in the distribution of milk, *see* Milk.)

Many thousands of such herds are needed to supply the enormous quantities of fresh milk and cream we consume daily. From their milk and cream we also get mountains of butter, cheese, condensed milk, and

other dairy products. Of all farm animals, the dairy cow is the greatest producer of human food, and intelligently managed it brings in large profits to the farmer the year around. The milk produced annually by one dairy cow has a food value equal to about four barrels of wheat flour, and the total it yields in its lifetime equals the meat of a dozen or more beef animals.

Dairying has become one of the important industries of the world, and improvement has been very rapid, especially during the past 50 years. Betterment of the dairy herd is of first importance. Formerly cows were milked only during the spring and summer, when pastures were available, and were poorly fed and allowed to go dry during the winter. Now cows are fed a well-balanced ration of dried feeds, alfalfa, and ensilage (*see* Silo) the year around. They are housed in clean, well-ventilated barns, given access to fresh water at all times, and are curried and washed. For this care, the dairymen are rewarded by a greatly increased, year-around milk production.

THE CONTENTED LIFE THAT BRINGS RICH MILK AND CREAM

Abundant pasturage, clean water, and freedom from annoyance enable cows to produce their best. The good dairyman always remembers that everything which makes his cows happier and healthier means better milk for human children.

In no other branch of animal industry have breeding and proper care made such great and profitable changes as in the dairy herd. One pure-bred cow may bring in as large a profit as 40 "scrub cows," and it will produce in a month as much milk as the wild cow would in a year. A good Jersey will produce its own weight of butter in a year. The Guernsey is also noted for the richness of its milk. Other favorite dairy breeds, such as the Ayrshire and Holstein, are valued for the large quantities of milk produced, although it is not as rich in butter-fat as the milk of the Jersey. (*See* Agriculture).

Keeping Books on the Cow

Milk contains from 2 to 8 per cent of butter-fat. The dairyman must know how rich the milk is in butter-fat, as well as the quantity given by each cow, in order to grade the milk and to tell which cows are profitable milkers. The invention of the Babcock test by Dr. S. M. Babcock, of the Wisconsin Agricultural Experiment Station, gave a convenient and practical means of testing for butter-fat. A little sulphuric acid is added to measured samples of the milk to be tested; this frees the butter-fat and dissolves all the other milk solids. Then the samples in individual bottles are put into the tester and whirled around very rapidly. This causes the butter-fat to separate from the heavier portion of the milk, rising to the top, so that the amount can easily be read from a scale on the neck of the containers.

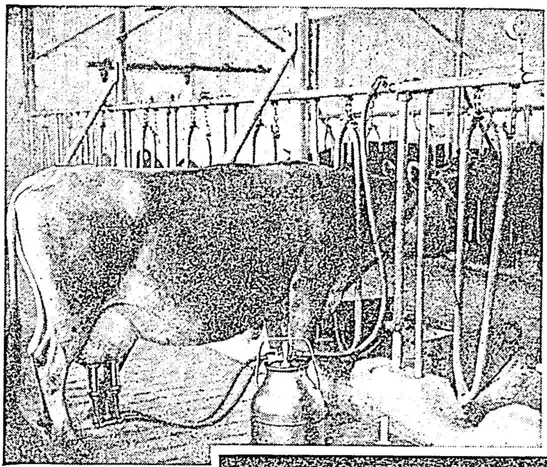
How a Cream Separator Works

The cream separator has made great changes in dairying. Before it came into use, pans filled with milk stood on the shelves of the dairy house for 24 to 36 hours until the cream rose and could be skimmed off by hand. This method left from 10 to 20 per cent of the fat in the skim milk. Now modern creameries use centrifugal cream separators, machines which vary in size from those small enough to skim the milk of one cow up to machines that can handle 10,000 pounds of milk an hour. These machines separate the milk so that less than 0.01 per cent of fat, as determined by the Babcock test, remains in the skim milk. Formerly milk was separated on the farm, the cream hauled to the butter factory, and the skim milk fed to the pigs and calves. This was wasteful, and in late years the tendency among farmers has been to sell the whole milk to the plants, where the skim milk is made into powdered skim milk and casein.

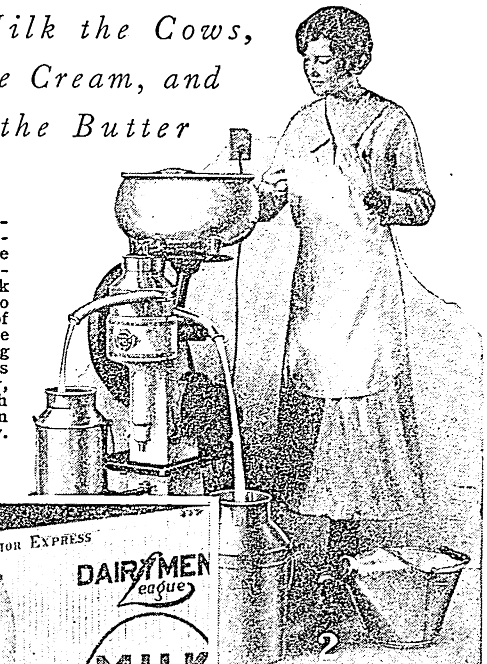
The cream separator works on the principle that the heavier a whirling body is, the greater its tendency to fly from the center. From a tank at the top the milk flows down into a large bowl or drum, which makes from 5,000 to 9,000 revolutions per minute. The cream, being lighter, stays in the center and is drawn off by a tube. The heavier skim milk, flying to the outside, is carried away by another tube.

MECHANICAL DAIRY MAIDS AT WORK

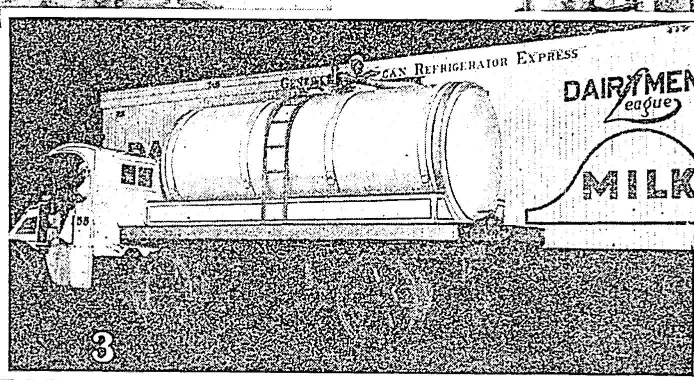
They Milk the Cows, Skim the Cream, and Churn the Butter



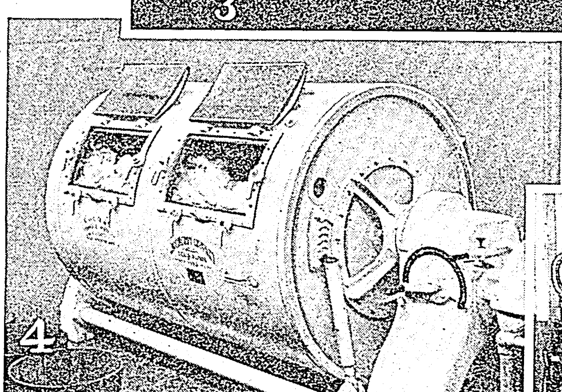
1. From cow to can by means of an electrical milking machine is the modern method. The milk is drawn by pressure and suction, and this mechanical dairy maid can milk a cow in from 4 to 7 minutes.



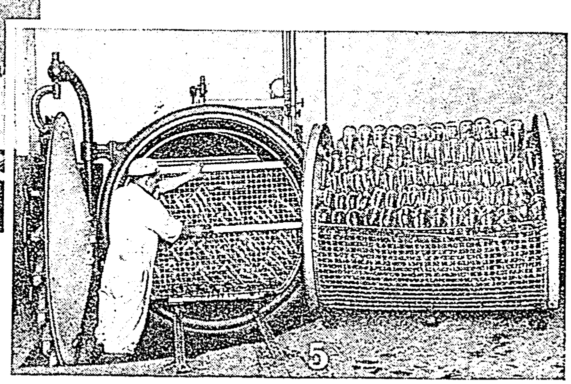
2. In this electric cream separator the heavier particles of the milk are thrown to the outside of the drum. The cream, being lighter, collects at the center, so that each can be drawn off separately.



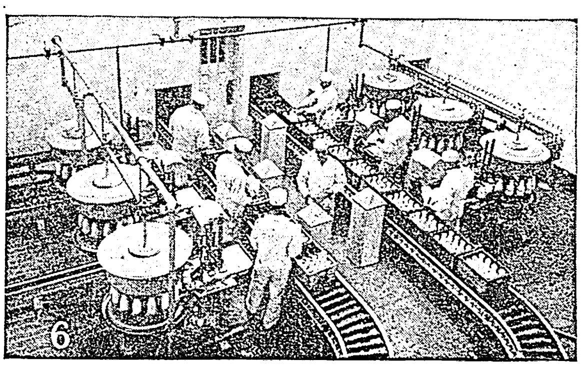
3. To transport the milk from the farm to the city there are huge trucks like the one at the left. The tank is really a big 8,000-quart vacuum bottle—a one-piece, seamless glass container covered with cork composition. It takes one man 10 minutes to load this truck. Three men would take 45 minutes to do this work if they used the old fashioned milk cans. The freight car, too, has two tanks, each of 24,000-quart capacity. These tanks keep the milk at a temperature of about 36° F. for a period of 16 to 20 hours.



4. A huge butter churn like the one above can make 1,000 pounds of butter at a time. The churns first make the butter, then work in the salt.

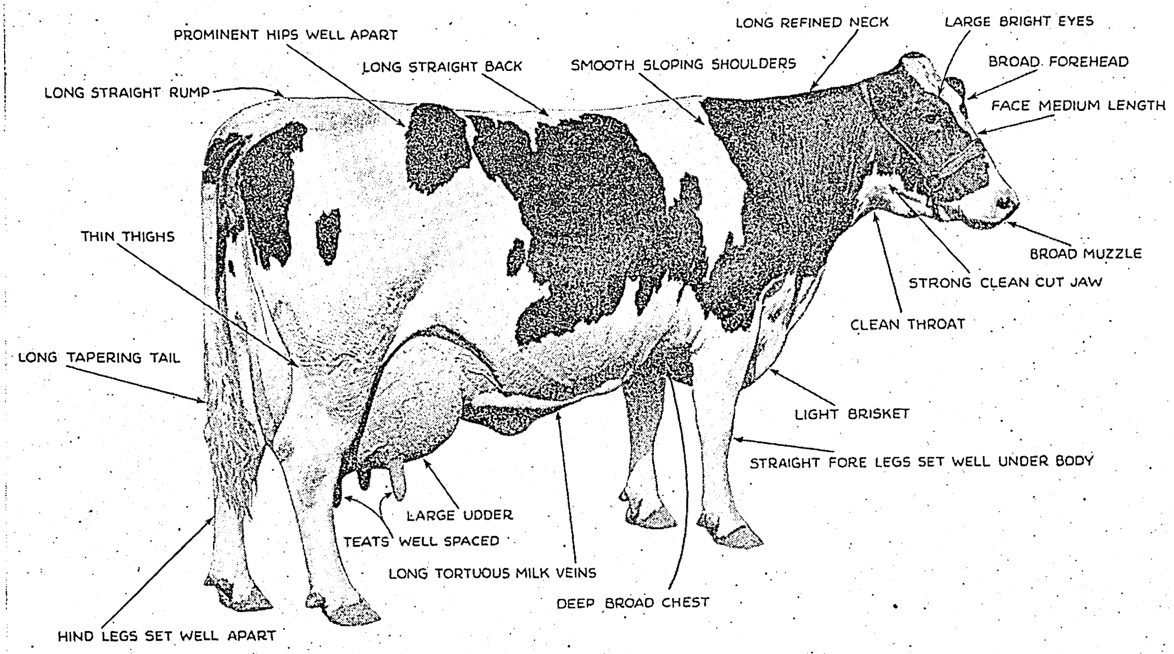


5. Great wire baskets, filled with bottles that have been carefully washed by machinery, are placed in the large drum above. In this drum the bottles are perfectly sterilized by heating.



6. The milk bottles go directly from the sterilizing drum into the bottling room at the left, to be filled with milk. The empty bottles come marching single file on a rack and are automatically filled under the large round containers you see in the picture. These containers are constantly kept supplied by pipes, and as each bottle takes a stand under the faucet, a valve opens and then closes as soon as the bottle is full. After the bottles are capped, an operator places them in a crate and they ride out on another rack to be collected for delivery.

FINE POINTS OF A CHAMPION DAIRY COW



This is the portrait of the champion dairy cow Carnation Ormsby Madcap Fayne of the Carnation Milk Farms, Seattle, Wash. In 1942 "Capper," as she was called on the farm, gave 41,943.4 pounds of milk—almost 21 tons. This meant a daily average for a year of 115 pounds or about 55 quarts. This far surpassed all previous world records and the cow, a Holstein-Friesian, illustrates perfectly the qualities that make a fine dairy animal.

Butter was made entirely on the farm until after the middle of the 19th century. A small batch of sour cream was placed in a little churn, and a dasher, pulled up and down by hand, churned the cream. The butter was washed and salted by hand, placed in one- to five-pound crocks, and sold locally (*see* Butter). In modern factories butter is made in great churns that handle from 50 to 1,000 pounds of butter. These machines churn the cream, and wash, salt, and "work" the butter. All cream used for butter in modern plants is pasteurized. If sour cream is received at the plants, the acidity is reduced by the addition of lime so that it can be pasteurized. After pasteurization a culture of bacteria called a "starter" is added. These bacteria are of two types: one produces lactic acid and coagulates the milk; the other produces volatile acids which give a pleasing flavor and aroma to the butter. Sometimes cream is permitted to "ripen" or ferment for a few hours, but never is it permitted to develop high acidity. Today a great deal of butter is made from sweet, unripened cream. In the making of ice cream and cheese, both milk and cream are used (*see* Ice Cream; Cheese).

Homogenized milk is sold in many cities. It can be recognized by the absence of a "cream line." It is produced by the breaking down of the fatty cream globules to a size so small they no longer float to the top but remain evenly distributed throughout the milk. In one method, jets of milk are driven against metal plates at a velocity of nearly a mile a second. In another method, the milk flows across a large metal diaphragm. A powerful electromagnet keeps the diaphragm vibrating back and forth more than 20,000 times a second. This produces in the milk what are called *ultrasonic* or *supersonic* waves (*see* Sound), and these cause the cream globules to disintegrate. Milk so treated has an altered flavor and a smoother body. Its curd is softer and more easily digestible—an important factor in infant feeding.

Trainloads of Milk for Cities

Once almost every city home owned a cow to supply the family with milk. As cities grew, they pushed the dairy cows farther and farther to the outskirts, and today most milk is transported hundreds of miles to the large cities. New York, for instance, receives milk from about seven states and two Canadian provinces; special trains daily bring milk nearly 500 miles to this great city.

Milk is the most nearly perfect food that comes to our tables. But how perishable it is! Bacteria find it an ideal medium for rapid growth and reproduction. Most of these tiny plants are harmless and even beneficial, but others produce contagious and deadly diseases. (*See* Bacteria; Milk.)

The teaching of sanitary methods to people handling milk; the inspection of cattle, barns, and milk plants by city and state boards of health; the development of dairy machinery and equipment; and artificial refrigeration make it possible for cities to buy sweet clean milk produced on farms many miles away.

In spite of all precautions, disease-producing bacteria may get into milk. To kill such bacteria, many cities require that milk be pasteurized (*see* Pasteur, Louis). The only milk that they allow to be sold without pasteurization is "certified milk." This is milk produced by certain dairies which conform to the most rigid sanitary requirements. The term "certified milk" is protected from misuse by registration in the United States Patent Office.

Modern plants are equipped to handle large amounts of milk rapidly, efficiently, and hygienically. Incoming milk undergoes chemical and bacteriological analyses. Then it is weighed and pumped into storage tanks. Before pasteurization, it is sometimes run through clarifiers, which whirl the milk rapidly and so rid it by centrifugal force of any sediment it may contain. After pasteurization, the milk is cooled rapidly to 50° F. or lower to arrest further multiplication of bacteria. Sterilized bottles coming directly from sterilizing ovens are automatically filled and capped. Large bottle-filling machines fill as many as 72 bottles a minute.

In total value of dairy products, Wisconsin, New York, Pennsylvania, and Minnesota are the leading states. Wisconsin makes the most cheese, and Minnesota the most butter. New York and Pennsylvania lead in the sale of fresh milk and cream. Other leading dairying states are California, Illinois, Ohio, Iowa, Texas, and Michigan.

The Netherlands normally supplies three-fifths of the total world exports of condensed and evaporated milk. It is also first in cheese exports. Denmark is the principal butter-exporting country and the Netherlands is usually third or fourth. Other countries that export large quantities of butter are New Zealand, Australia, the Soviet Union, Ireland, and Argentina. The principal exporters of cheese are the Netherlands, New Zealand, Canada, Italy, Switzerland, and Denmark.

Life of a Cow on a Modern Dairy Farm

DAIRYING is an occupation for the patient man. Each cow is an individual who must be treated with sympathy according to her special needs and traits. Each will resent and resist brutality or harshness, and will be disturbed by any sudden changes of her environment or daily routine. "Milk from contented cows" was the slogan adopted by one of the big American dairy companies. Every good dairy farmer knows that contented cows do give more and better milk.

So the up-to-date dairyman provides a clean and snug barn. In it are stalls of a size for his particular breed of cattle, arranged so that his animals will not have to face the glaring sun. The stanchions that hold their necks allow the greatest possible freedom. The gutters behind them are deep to make for cleanliness. The manure is removed daily. Barn floors are of some nonconductor of cold and moisture, such as cork blocks or creosote wooden blocks. Beneath the blocks are further insulation and a cement foundation. There is ample ventilation, but muslin stretched on wooden frames may be placed over window openings to prevent drafts. Feed is given morning and evening and the cows are milked, either by hand or machine, while consuming it. The feed consists of a well-balanced ration of protein and fats in addition to roughage. Salt is added to make the feed more palatable and to promote health. Hay is not fed until later because dust from the hay might contaminate the milk. Water is given before the morning feeding and after the afternoon feeding. The water should be warmed to about 75°F. Each cow consumes from 12 to 20 gallons a day while she is producing milk. If the weather is not too cold the cows are exercised out of doors twice daily. In bitter weather they should be permitted the run of a part of the barn for a short time morning and afternoon. Spraying with a fly-killing liquid in summer prevents much kicking, head tossing, and tail swishing and encourages the cow to let her milk down easily. In a word, the dairyman tries to provide the year-round conditions like those of spring and early summer, when the cow naturally tends to produce the most milk.

DAISY. The "day's eye," as it was known in Old English, is like a miniature sun surrounded by its rays. These beautiful wild flowers carpet meadow and roadside from May until November.

The common field, or ox-eye, daisy is a species of chrysanthemum native to Europe (*Chrysanthemum leucanthemum*). Tradition says that it was a stowaway in hay brought to America to feed the horses of Burgoyne's army. Its white blossoms, from one to two inches across, are borne on smooth, erect stems from one to three feet high.

The true, or English, daisy (*Bellis perennis*) is white tinged with pink, the "wee, modest, crimson-tippèd flower" of which the poet Burns sang. It has one representative in America (*B. integrifolia*), which grows from Kentucky southwest to Texas. The black-eyed Susan, or yellow daisy (*Rudbeckia hirta*), is a handsome and common flower.

The striking Shasta daisy, a hybrid developed by Luther Burbank, has a gold center with white petals in a circle from four to six inches across. Christmas and Michaelmas daisies are species of asters. All daisies are members of the family *Compositae*.

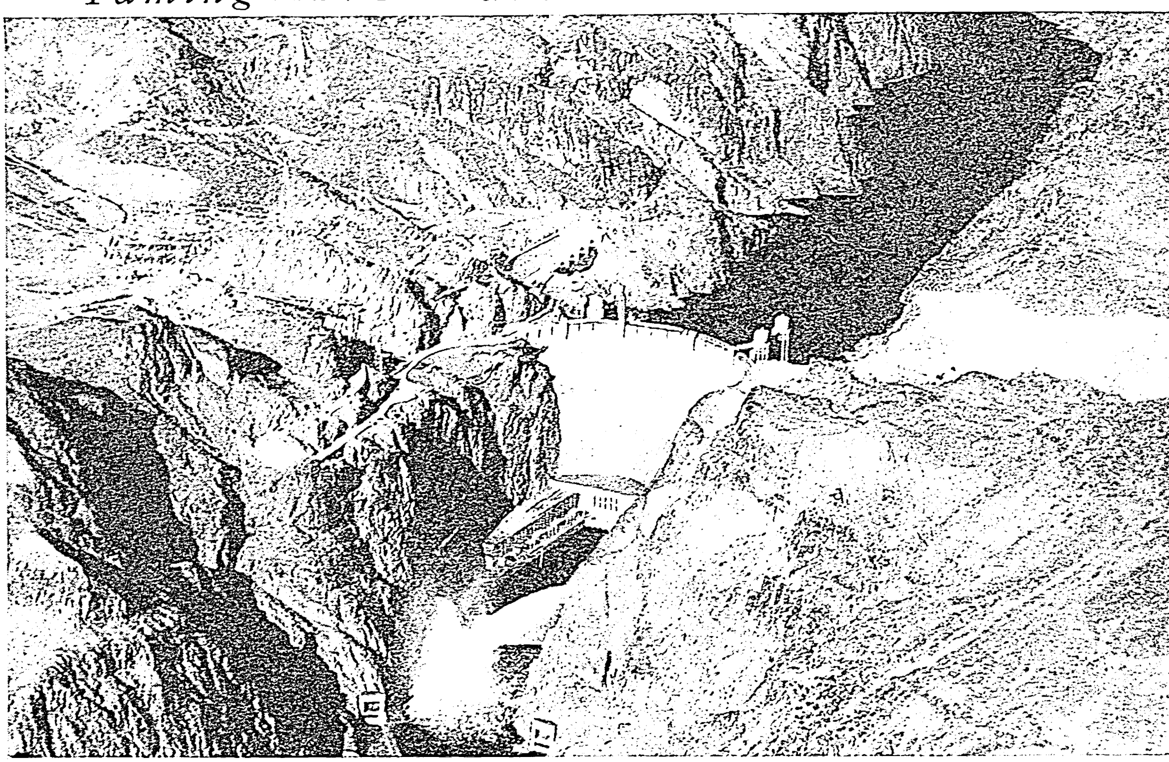
DALLAS, TEX. With its skyscrapers, its teeming streets, its enormous railway yards, and its great factories, Dallas, the second largest city of Texas, seems like a city of the North set down under the gracious skies of the South. Like many northern cities too it has had an amazingly swift growth.

Dallas owes its prosperity to the fact that it is located in the great Black Waxy Belt of Texas, that stretch of black loam which is one of the richest agricultural regions in the world. The city is the chief distributing point for this cotton, corn, fruit, and wheat country. It is one of the largest inland cotton markets in the world and is the headquarters for many large oil companies. Dallas leads in the manufacture of cotton-gin machinery, saddlery, and leather goods. It also has important flour and grist mills, petroleum refineries, cement plants, iron and metal works, and textile and cottonseed-oil mills.

Draw a circle around Dallas with a radius of 100 miles and you take in nearly one-third of the people in Texas. That is one reason why the annual state fair at Dallas is outstandingly successful. Fair Park was the site of the 1936–37 Texas Centennial Central Exposition, which celebrated the 100th anniversary of Texan independence. Leading educational institutions are Southern Methodist University and Baylor University's schools of medicine, dentistry, and nursing.

The history of Dallas begins with a log hut built by John Neely Bryan in 1841. This grew to Peters Colony, which in 1845 adopted the name of George M. Dallas, vice-president under Polk. Dallas was incorporated as a city in 1871, with about 5,000 population. Government by a commission, with a mayor and four commissioners, was adopted in 1907; council-manager government was adopted in 1930. Between 1928 and 1931, the Trinity River was straightened through the city, ending flood dangers and reclaiming 10,000 acres of land. Population, 294,734.

Taming RIVERS *and* DESERTS *with* DAMS



This airplane view of Boulder Dam shows how the huge structure aids civilization in the Southwest. Flood waters which formerly ravaged lower stretches of the Colorado River are held behind the dam until wanted. When they are released, they pass through a hydroelectric generating station, yielding power, and emerge in huge jets to supply water to the lower river.

DAM. To realize how much dams can do for man, let us consider why the United States spent $165,000,000 to build Boulder Dam in the American Southwest.

In the first place, here was a vast, arid region which needed only water to become productive; and through it ran the Colorado River carrying an immense volume of water. But the water came in floods in May, June, or July; thereafter the supply was only enough to irrigate the Imperial Valley. Again, southern California cities were wondering where to get more water as populations continued to grow. Water from the Colorado seemed to be the answer. Power, too, could be obtained, if the river's waters were harnessed.

The difficulties, however, were tremendous. Any dam able to tame the Colorado would have to be the biggest structure ever built by man. The work would have to be done in a desert, under blistering summer heat; and the cost would be staggering. But these problems were solved, and today Boulder Dam holds ample water for irrigation and for cities; the region has a fine freshwater sea for recreation; and the sale of power is expected to pay the cost within 50 years.

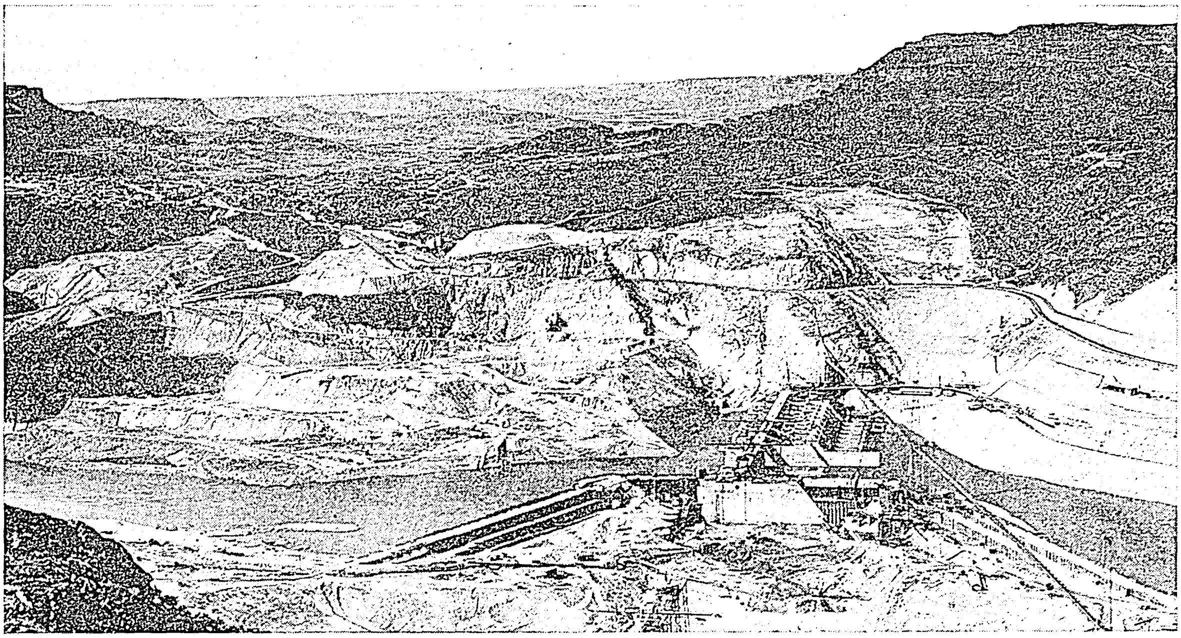
Such benefits are typical of what dams are accomplishing the world over—as we can see from the very nature of a dam and what it does.

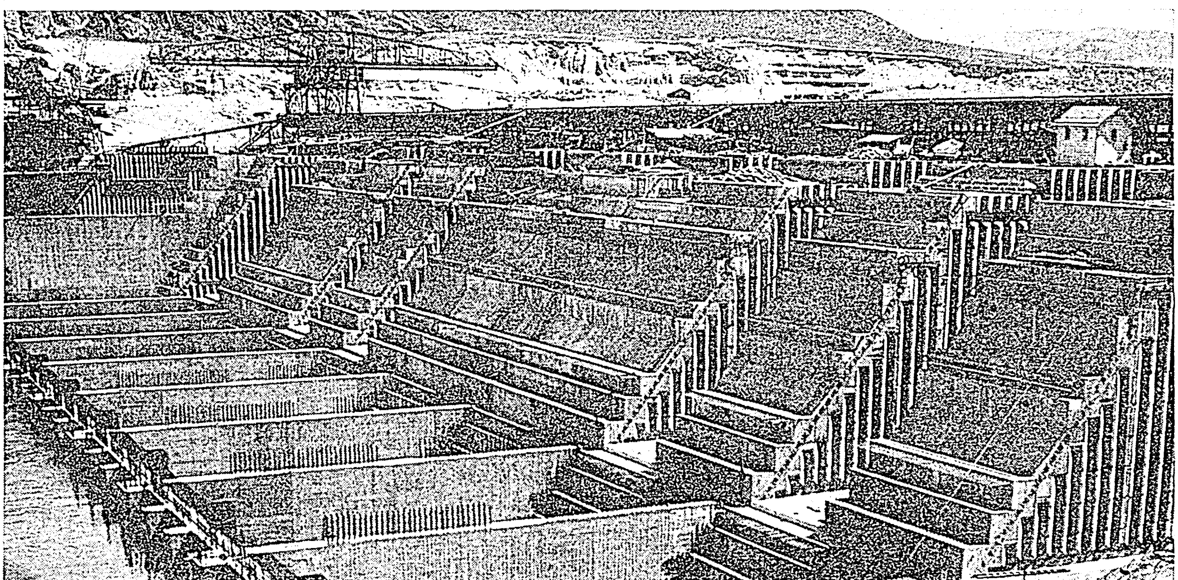
The Nature of a Dam and Its Work

A dam is defined as a bank or wall placed across a watercourse to confine and keep back flowing water. A dam usually stops all flow, except floods; a structure intended to permit flow, once a certain depth of water has been held back, may be called a *barrage*. A small dam may be called a *weir*.

Once a dam is built, water piles up against it, and the water surface becomes level, instead of sloping

THE BIGGEST DAM EVER UNDERTAKEN





Here are two views showing work on the Grand Coulee Dam across the Columbia. In the upper picture, looking west, we see the river in the foreground and in the background the Coulee, which appears as a wide notch in the plateau above the dam. This was the old bed of the river ages ago. The west foundation of the dam is in place, and the east end is being built behind a coffer-dam. The huge size of the job is made plain by the tininess of the buildings in the foreground. In the lower picture we see several completed blocks in the west portion; the high fluted sides interlock with blocks which were later built into the gaps.

as it does in a river. This level surface spreads until it meets land on each side, and it backs upstream until it meets the stream surface. Thus a dam creates a *reservoir*, or storage space, in the river. By providing outlets through or around the dam, with gates, valves, or other controls, the amount of water held and the amount released can be regulated.

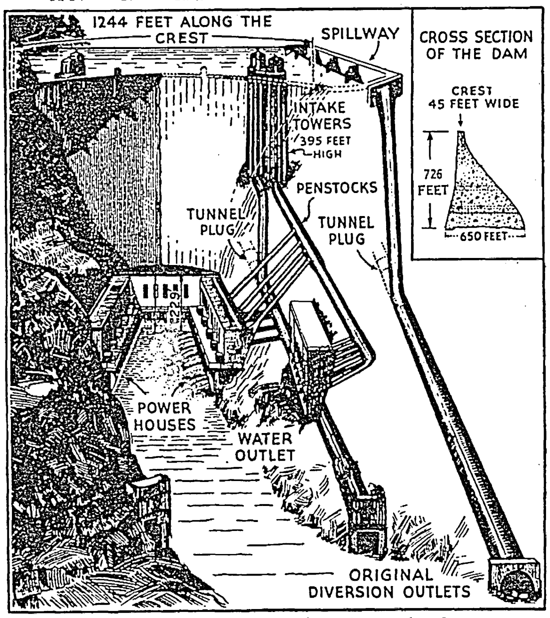
Storage, Navigation, and Irrigation Dams

Boulder Dam is a good example of a *storage*, or *impounding*, dam, used to hold back water until wanted. Such dams also may be used to hold water for a city; New York City's reservoirs hold enough water in reserve to meet the city's needs through several years of deficient rainfall.

Again, a sharp drop or a narrowing in a river bed may block navigation by a waterfall, a rapids, or a swift current. Usually canals are built around such obstacles (*see* Canals); but occasionally a dam with a canal lock can be built to "drown" the obstacle. Bonneville Dam, 42 miles east of Portland on the Columbia River, does this. The Tennessee River has been made into a stair-like series of lakes, by dams.

Dams are used in irrigation not only to store water, but also when a river has cut its bed far below the land to be irrigated. In a situation like this, a dam can be built to hold water upstream at a high level; then the water can be let down to the land through a system of canals.

AN "X-RAY" OF BOULDER DAM



The left half of this artist's drawing shows the dam as seen from downstream; the right half shows the construction inside the rock of the canyon wall. Water from the reservoir normally passes through the intake towers, penstocks, and turbines, to generate power; the water outlet can release an extra supply if desired. The spillway can carry off flood water when necessary. The huge horizontal tunnels were built first, to carry the river around the site while the dam and other structures were being built; then the reservoir ends were plugged, and the tunnels are used as shown.

Dams for Power or Flood Control

Hydroelectric power dams are expected, first of all, to generate power enough to repay the cost of construction. The probable output depends, first, upon the *head* of water, or height of stored water above the turbines. The higher the water is, the more weight and pressure it brings to bear upon the turbines. The second factor is the *volume* of water throughout the year. The minimum flow in dry months fixes the amount of *firm* power, which customers can rely upon receiving regularly. Sometimes a market can be found for extra power generated in flood seasons. Such *run-of-stream* power is sold at a low rate. Finally, the yearly charge to repay cost, and the cost of transmitting the power to markets, should not exceed the cost of power generated by steam in the markets.

We often hear that such dams will help control floods, and they may. For flood control, however, a reservoir should be kept empty until the flood comes; if it is used for storage, the ability to control a flood is lessened by the amount stored (*see* Floods).

Selecting a Site for a Dam

A dam must, of course, be strong. Its strength depends, not only upon the dam, but upon the foundation and the abutments on either side. These are more likely to weaken and cause floods than the dam itself. Engineers therefore examine the site for weak rocks, faults, or other defects. Porous soil or rock is avoided for fear water will seep under or around the dam and weaken it. If test borings and other studies reveal weaknesses in one site, another may be used. Boulder Dam, for example, was built in Black Canyon, where a dam strong enough to hold two years of flood water could be anchored in strong volcanic rock, instead of in Boulder Canyon, where the site was found defective.

Various Types of Dams

A simple type of dam is the *earth* dam, made by heaping earth across a river. It may have a core of masonry or concrete inside the mass to prevent seepage of water, and it may be faced with hard material. The fill may be made with rock instead of earth. Such dams are built when the materials can be obtained easily, and will hold the weight of the impounded water.

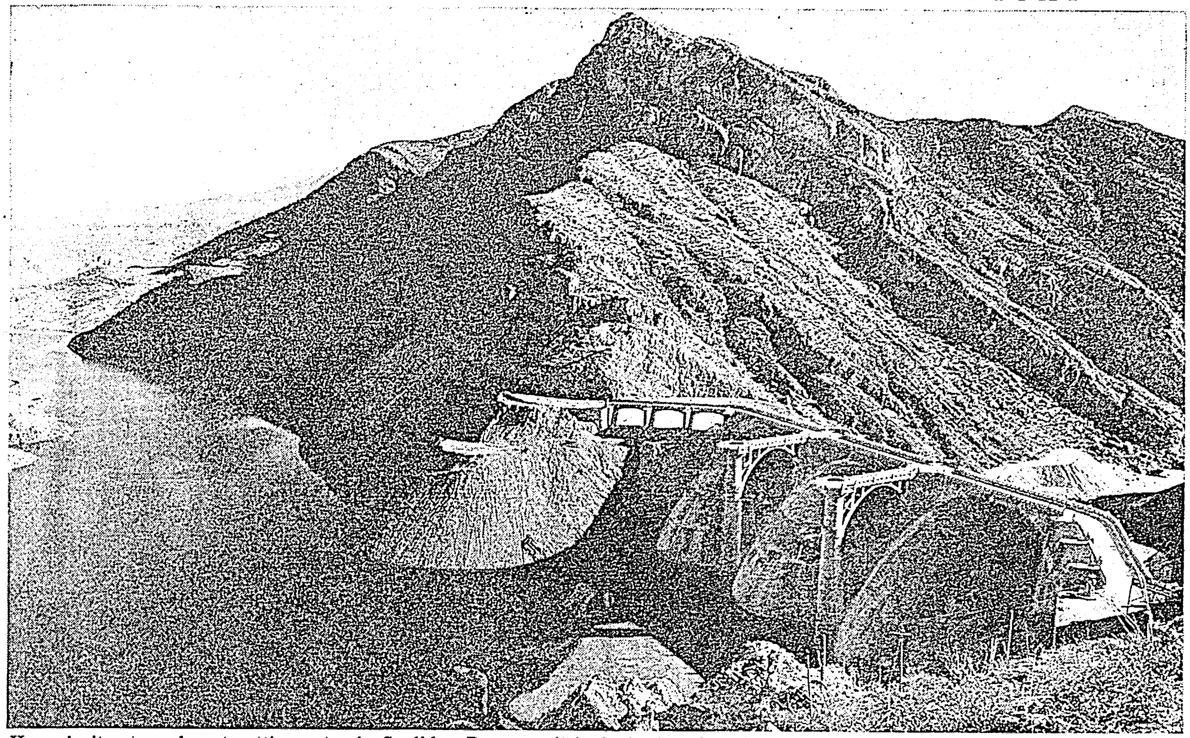
For higher, stronger dams, concrete or masonry is used. Some of the dams, called *gravity* dams, hold back the water as an earth dam does, by sheer weight. A high dam built in a narrow canyon may be shaped as a horizontal arch, with the convex face upstream. The shape, as well as the weight and material, gives strength (*see* Arch), because much of the thrust is borne by the abutments. Hence much less material is needed than a gravity dam would require.

Wide canyons can be dammed by using *multiple arches* that rest on abutments at each end of the dam, and upon buttresses in the midportion. *Half domes* can be used instead of arches; this gives arch strength vertically as well as horizontally. By this method, the Coolidge Dam in Arizona was built with only 204,000 cubic yards of concrete; a gravity dam of the same strength would have needed 357,000 cubic yards.

Reservoirs, Control Works, and Power Plants

Many problems are raised by the reservoir which the dam will fill. If much water is stored in a flat val-

HOW DOMES MAKE A DAM BOTH STRONG AND LIGHT



Here, in its stern desert setting, stands Coolidge Dam, as it looked when just finished and before the Gila River had filled the reservoir and concealed the structure. The body of the dam is exceptionally light for its strength because, as the text explains in greater detail, it consists of three half domes and buttresses.

ley, for example, considerable land is flooded, and all owners must be compensated. Often towns must be rebuilt on higher land. If drinking water is to be stored, the whole area must be stripped of organic matter which might be contaminating.

Water can be taken from the reservoir in canals, if the surrounding land is not too high above the reservoir. If the land is too high, as in a canyon, tunnels are driven through the rock around the dam, or are placed in the dam itself. Water used for power is led to the turbines through large pipes or tunnels called *penstocks*.

Flood water which the reservoir cannot hold may be allowed to flow over the crest of the dam; the crest may have control gates. Earth dams, however, and those with foundations which might be damaged by water falling from the crest, have *spillways*. These are paved aprons down the face, or separate paved channels.

Ingenious Methods of Dam Construction

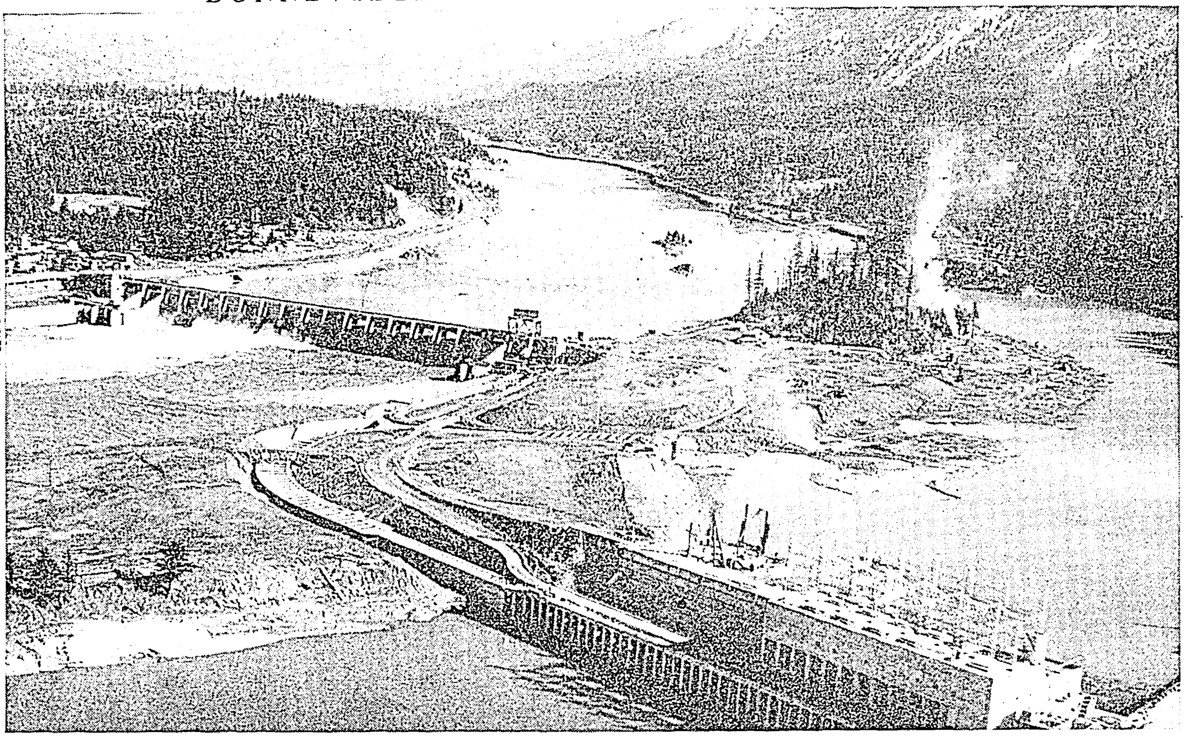
If a dam is to be built in a remote place, often the first job is building a railroad or road to haul supplies and a town to house workers. Then the river must be diverted to expose the site. The site itself is protected with a *coffer-dam*, or water-tight enclosure. Then the *overburden*, or loose rock and soil above the foundation, must be stripped away.

Large concrete dams must be made in sections, because one solid mass might expand or contract dangerously with changes in temperature. Pouring the concrete in the sections and placing machinery and other materials at the dam site are engineering problems in themselves. Traveling *cableways* are often used. Cables are suspended across the site from two towers, which travel on tracks along opposite sides of the site. Materials are conveyed on the cables to any desired point. At Boulder Dam there were five major cableway units, each with a carrying capacity of 25 tons. Two of them had spans of nearly half a mile.

The 10,000,000 tons of sand and gravel for Shasta Dam, near Redding, Calif., were transported from the Sacramento River to the dam on a belt conveyor 9.6 miles long. The belt was divided into 26 sections, each from 850 to 3,240 feet long. At the belt-junction points were 26 transfer stations, which housed the 200-horsepower motors for each section and the chutes through which the material passed from one belt to the next. The capacity was 22,000 tons a day.

Chemical changes create heat in concrete when it dries. Boulder Dam would have taken 125 years to cool if the concrete had not been chilled with refrigerating pipes containing cold brine. This method was also used at Grand Coulee, both for the concrete and also to freeze wet earth which was breaking loose in landslides. Grand Coulee presented another problem. Winter temperatures in this region fall as low as —28°F. To prevent freezing of the control gates, a gigantic heating apparatus was installed in the spillway and at each end of the eleven gates. Steel plates, each from 875 to 1,100 square feet in area, are heated by electric wiring.

BONNEVILLE DAM AND ITS FISH LADDERS



In the background we see the main channel of the Columbia River, and at the left the downstream side of Bonneville Dam, 42 miles east of Portland, Ore. On the island may be seen the fish ladders—steplike pools to carry salmon above the dam. The dam threatened to destroy a fishing industry, worth many millions, by cutting salmon off from their breeding grounds. At the lower right is the powerhouse. Cheap hydroelectric power has attracted new industry to this relatively undeveloped region. A ship lock, not visible in the picture, permits ocean-going vessels to ascend the Columbia as far as The Dalles, Ore.

Federal government dams usually are built by Army engineers if navigation is involved, and by the Bureau of Reclamation for irrigation projects.

Some Record-Breaking United States Dams

Boulder Dam is on the Colorado River across the Arizona-Nevada boundary, about 25 miles southeast of Las Vegas, Nev. Its height of 726 feet above bedrock dwarfs the Washington Monument by 171 feet. Its reservoir, Lake Mead, is 115 miles long, with a shore line of 550 miles. The National Park Service administers the lake and its shores as a recreational area and wildlife preserve. Boulder Dam can generate 1,835,000 horsepower of electric energy. The sale of power is expected to repay the cost of $165,000,000 within 50 years.

Part of the Boulder Dam project is the All-American Canal, which irrigates the Imperial Valley in southern California. The 80-mile canal, with its 130-mile extension north to Coachella Valley, taps the river at Imperial Dam, 300 miles below Boulder Dam. It replaces the old canal which looped down into Mexican territory (*see* California). Also a part of the project is the 242-mile aqueduct from Parker Dam, 155 miles below Boulder, to Los Angeles (*see* Aqueduct).

In 1934 an even larger dam was started on the Columbia River at the Grand Coulee, about 150 miles below the Canadian border, in the state of Washington. It was completed early in 1941, two years ahead of schedule. This $400,000,000 irrigation and power project is one of the most monumental undertakings in history. Its cost is $25,000,000 greater than that of the Panama Canal. The dam is not so high as Boulder Dam (550 feet), but it is three times wider. Its capacity of 2,420,000 horsepower is the world's greatest single source of hydroelectric energy. It will irrigate 1,200,000 acres, an area almost as large as the state of Delaware. The reservoir, 151 miles long, extends to the Canadian border. (*See* Columbia River.)

Another huge structure is Shasta Dam, started in 1938 on the Sacramento River near Redding, Calif. It is a part of the $170,000,000 Central Valley project to control floods, generate power, irrigate the valley, and improve navigation (*see* California). With a crest length of 3,100 feet and a height of 560 feet, it is second in size to Grand Coulee.

The foregoing are all concrete dams. The largest earth dam in the world, at Fort Peck, Mont., impounds flood waters of the Missouri River for release when needed to aid navigation on the lower river. It is also designed to generate power and irrigate farm land. The upstream face of the dam slid away in September 1938, because of a displacement of the foundations. Repairs were immediately undertaken. (For statistics about these and other large dams, *see* **Dam** in FACT-INDEX at the end of this volume.)

DAMAS'CUS (or *Esh Sham*), SYRIA. Before Athens was built, or Rome; before Moses led the Israelites out of Egypt, Damascus was a famous city. It is mentioned in Genesis (XIV, 15), and we know its history through 4,000 years from then until now. It may be the oldest of all cities now inhabited.

The city lies in a lovely green plain, watered by the Barada River, near the desert. Its gardens are rich with oranges, lemons, citrons, pomegranates, mulberries, plums, walnuts, pears, figs, apples, and cucumbers. It is a sacred city as well. The Arab patterns his idea of Paradise upon it, and thousands of Mohammedans gather here yearly for their pilgrimage to Mecca. It is rich in historical memories—how King David and the Israelites captured it, as did the Assyrians later, under Tiglath-Pileser III; how Paul was

TALKING POLITICS AND HIGH PRICES IN DAMASCUS

It is a far cry from this sidewalk café in distant Damascus to the general store of an American cross-roads village. But the idea is just about the same. Instead of discussing the price of corn and hogs, these dark-skinned gossips are probably telling each other about the shortage in camels, while they puff on the "hookahs" or water-pipes.

converted while on his way to persecute the Christians of Damascus; how it was captured by the Crusaders. Here died Saladin, the great enemy of the Crusaders in the days of Richard Cœur de Lion, and here he lies buried.

No city is more oriental in appearance than Damascus. From a distance its great expanse of low-lying Arab houses, overtopped here and there by the graceful minarets of the 248 mosques, seems very picturesque; but when you come nearer, you find that the streets are narrow and crooked and dirty, and the houses seem very dingy and dilapidated. But their mud fronts and grated windows with red shutters give no indication of the luxury of some of the interiors, where you find rich rugs and draperies, striped divans, and marble-paved courts with fountains.

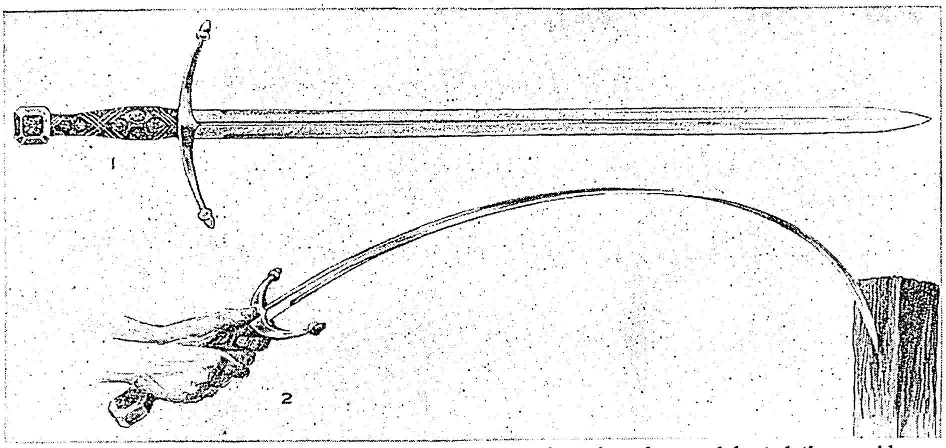
The life of this merchant city of the desert centers in its khans and bazaars. The "great khan," with its Moorish gate and its black and white marble cupola supported on granite pillars, is a magnificent structure. In this and several lesser khans (walled caravan headquarters), trading goes on in a cool twilight to the pleasant sound of fountains. The bazaars are noisier and busier, being simply streets of shops hardly bigger than a bootblack's parlor, where bright silks, rugs, metal work, fruits, roast meats, confections sweetened with honey and grape syrup, shoes, cloth, and other articles are temptingly displayed. Each kind of goods has a street or part of a street to itself. The longest and busiest bazaar of all—the "Straight Street" mentioned in connection with St. Paul's conversion—is roofed for its whole length of a mile and a half, and as seen from some minaret looks like a great lead pipe traversing the city. One of the regrettable features of the bombardment of 1925 (*see* Syria) was the damage done to this historic thoroughfare.

The looms of Damascus have been famous for many centuries; and in this city, where everything is still done in the most primitive way, where meal is ground in stone mills turned by camels, you may still see the hand looms worked by a weaver and his draw-boy. On these looms are made the beautiful damasks, woven in silks of brilliant colors, that were known throughout Europe and Asia as early as the time of the Crusades. (*See* Textiles and Embroideries.)

Few of the Damascus blades, for which Damascus was also famous in the Middle Ages, have been forged there since 1399, when Tamerlane, the terrible Tatar conqueror, raided the city and carried off all the great armorers to his own capitals. These blades were so keen that you could cut floating gossamer with them; so hard that they would shear an iron spear in two as if it were a reed; and so elastic that they would bend to a right angle and then spring back as straight as ever. The twisting and welding of two grades of iron or steel gave them their cutting properties and also

contributed a beautiful watermark pattern. To make them still more beautiful the Damascenes inlaid them with marvelous designs done in gold and silver.

THE FAMOUS "BLADES OF DAMASCUS"



Like the swords of Toledo, Spain, the Damascus weapons have long been celebrated the world over for their exquisite workmanship, razor-sharp edges, and perfect temper. The method of making them left a peculiar pattern on the surface of the metal, and today steel which wears this pattern is everywhere known as Damascus steel.

Damascus today is still famous for this exquisite inlay work in metals.

The first mention of Damascus is in Egyptian records of about 4,000 years ago. After 1200 B.C. it became the most powerful of a group of Aramean kingdoms that long defied Assyria. In 732, however, Tiglath-Pileser III crushed its walls. The Bible tells of David's conquest of Damascus. In 333 B.C. it fell prey to Alexander, and in 63 A.D. to Rome. From 635 to the time of the first World War Damascus was in Arab and Turkish hands, except for a brief interval when it was held by the Crusaders of the 12th century.

DAM'OCLES. The uncertainty of human happiness is illustrated by the story of Damocles, who was one of the courtiers and flatterers of the elder Dionysius, tyrant of Syracuse, in Sicily, in the 4th century B.C. According to the story, Damocles once extolled in the highest terms the grandeur and happiness of the king, and was reproved in a singular way by Dionysius. He was placed at a magnificent banquet, surrounded by all the splendors of royalty. In the midst of his enjoyment, suddenly looking upward, he saw a naked sword hanging by a single horsehair above his head typifying the uncertainty of a ruler's life. The "sword of Damocles" has thus become a proverbial expression for uncertainty and danger.

DAMON AND PYTHIAS. The world has no more beautiful story of friendship than that told in ancient times of Damon and Pythias. Pythias (or, more properly, Phintias) because of his opposition to Dionysius, tyrant of Syracuse, was condemned to death. He begged to be allowed to return home to bid farewell to his wife and child. Damon came forward and offered himself as surety for his friend, promising to die in his stead if Pythias did not return.

The time of execution approached. Pythias had not come and Damon was already at the place where he was to die when Pythias suddenly rushed through the crowd into his arms. His horse had been killed, and it was only through an almost superhuman effort that he was able to arrive in the nick of time. Then each of the friends pleaded to be allowed to die for the other. Dionysius was so moved that he pardoned them both and begged that he might be allowed to share in their marvelous friendship.

The Knights of Pythias, a fraternal society, founded at Washington, D.C., in 1864, takes its name from the Pythias of this charming story from ancient Greece.

DAN'DELION. A welcome sight in the early spring are the first bright blossoms of this—

Dear common flower that grow'st beside the way,
Fringing the dusty road with harmless gold.

Although abhorred by the diligent gardener as a troublesome weed, the dandelion is a delight to the children who make curls and ribbon chains of its long hollow stems, and to the housewife to whom it supplies healthful "greens," prepared in much the same manner as spinach.

The dandelion is a native of Europe and Asia, but has become naturalized throughout all temperate regions. It is a member of the composite family. The root is long and bitter, and when ground and roasted is at times used as a substitute for coffee. The leaves are long and irregular, with jagged points inclined towards the stem and so arranged that rain easily finds its way to the roots. Each golden flower is composed of innumerable tiny florets, held in a cup of green and set singly on the tip of the stem. Bees, wasps, butterflies, beetles, flies, and hundreds of other insects visit it for its abundant supply of nectar and pollen. The blooming season lasts throughout the summer, the brilliant blossoms soon turning to white fluffy pappus balls whose seeds are scattered by the winds, gaining for it the name of blowball.

Scientific name, *Taraxacum officinale*. Flower round, single, of golden yellow, containing 150 or more perfect florets at the top of a hollow milky stem, from 2 to 18 inches tall. Leaves spatulate and irregularly jagged, growing from a deep bitter root.

DANTE (*dän'tā*) **ALIGHIERI** (1265–1321). The Middle Ages were just brightening with the dawn of the Renaissance when Italy's greatest poet—and one of the greatest of all lands and times—was born in Florence, of a family belonging to the lesser nobility. As with so many other great men, a halo of legends

surrounds his early life, but the essential facts are told in his book entitled 'Vita Nuova' (New Life). When only nine years old he met the Beatrice of his later poems and formed a passion for her which never cooled and which influenced the whole course of his later life.

Dante's education gave him a mastery of the Latin learning of that day, and as a citizen of one of the chief of the little city-republics he played his part in the political and military conflicts—primarily those of the Guelfs (party of the Pope) and Ghibellines (party of the Emperor)—which were tearing all Italy to pieces. He rose to high office in Florence, and was sent on an embassy to the Pope at Rome in 1301. When the victory of the more extreme party in Florence (the Black Guelfs) resulted in the banishment of the leaders of the opposite party (the White Guelfs), Dante was included (1302); and later he with others was condemned to be burned alive if caught.

The remainder of the poet's life was spent in bitter exile. He himself says: "Through almost all parts of Italy, a wanderer, well nigh a beggar, I have traveled, showing against my will the wounds of fortune." His sympathies now were entirely with the Ghibelline party, and he looked—though in vain—to the Emperor in Germany as the source from which unity and order should come to cure the anarchy of Italy. He died in 1321, in Ravenna, a quaint old Italian city situated among the lagoons of the Adriatic some distance south of where the River Po enters that eastern sea.

There in a marble urn still repose the poet's bodily remains, beneath a tomb which the poet Byron calls "a little cupola more neat than solemn." The portrait by his Florentine friend Giotto preserves for us his features as they were before the cares and sorrows of exile had left their marks upon that noble countenance. But his true monument, known and loved by poets, artists, and scholars everywhere, is his immortal poem, the 'Divine Comedy'.

No work except the Bible and Shakespeare's plays has given rise to so much literature. It was copied in 600 manuscripts before the invention of printing, and about 300 printed editions have been issued. It has been more than 300 times translated into foreign languages; and unnumbered introductions, essays, and commentaries have been written on or about it. Dante had not been in his grave 20 years before Italy instinctively recognized that this was her greatest man. About 50 years after Dante's death a public lectureship on the 'Divine Comedy' was established at Florence, to which the first appointee was Boccaccio the founder of Italian prose, as Dante was of Italian poetry.

The 'Divine Comedy'—Dante's Immortal Masterpiece

TO English-speaking peoples the poet Dante is the least known of "the five" that, as Emerson says, "the centuries do survive." This is not because he wrote in Italian, for Homer wrote in Greek and we all know the stories of the 'Iliad' and the 'Odyssey'. But the matters that Dante deals with are of a less popular character; and those who are able to read his 'Divine Comedy' in the original say that much of his sublime harmonies of sound and sense is lost in translation. Still, the best renderings of this classic into English blank verse do preserve the grandeur of theme and style, and many a passage of matchless beauty.

This classical work of literature probably could have been written in no other country than Italy, and at no other period in history than in the beginning of the 14th century. The splendors of the age of Catholic faith were not yet past; the rich and towering Gothic cathedrals were still slowly building; the last of the Crusades was barely over with, and the medieval universities with their subtle learning in law and theology were at the height of their fame and influence. Although Dante preceded Columbus by nearly two centuries, his age, especially in the city of Florence where he was born, was one of superior men, of free thought and speech, of original genius, and adventurous undertakings.

The time was favorable for the appearance of a great imaginative work of literature of the most daring form and conception. Discarding Latin, in which all important writing was still done, Dante used the Italian of his native Tuscany, at that time almost as rude and unformed a literary tongue as was English in Chaucer's day. He chose a new theme, invented his own style, and raised Italian to the dignity of a literary language.

While the 'Divine Comedy' is written in the grand manner, it does not deal with the events and characters of heroic story, and so does not fall within the definition of an epic. Neither is it strictly allegorical, as is Spenser's 'Faerie Queene'. Dante himself said of it: "The subject taken literally is the condition of souls after death; but taken allegorically the subject is man, how by merit or demerit he justly deserves rewards or punishments." It might be described as a spiritual 'Odyssey'. The hero of his mystical adventures was the poet himself, the actors were mainly historical characters known to the audience for whom he wrote, and moral discourses take the place of episodes.

The 'Divine Comedy' is a descriptive narrative of an imaginary journey through "the world of souls," of Hell, Purgatory, and Heaven. Beginning on Good Friday of the year 1300 and ending on the Sunday after Easter, the time of action covered by one of the longest and most dramatic poems ever written is only ten days. In learning, invention, and imaginative powers the 'Divine Comedy' has never been surpassed. From one startling scene to another the poet

passes, reviewing rapidly the processions of shades from classical mythology and centuries of history, and with the certainty of one so wrapped in his visions as to make them the only reality. We see the souls of the dead as he saw them, in torment, or floating like golden bees in the azure from star to star. As the French critic Taine says: "His cries of anguish, his transport of joy, the succession of his infernal or blessed phantoms, carry us with him through that invisible world."

When the action begins, Dante is lost in a forest, with his upward way barred by wild beasts. This is understood to be symbolic. The beasts were the sins which keep us from our desire for a holier life. To help him with reason and repentance, the shade of the poet Vergil appears and guides him through the lower regions of the next world. Taken across the River of Death in his sleep by the grim ferryman of lost souls, Dante awakes on the brink of Hell. Here he is obliged to pass through a gate above which is cut the terrible inscription:

> Through me you pass into the city of woe.
> All hope abandon ye who enter here.

The Inferno or Hell of Dante's vision is a vast conical abyss which, by narrowing terrace-like ledges or circles, separated by steep descents, reaches to the center of the earth. As every lost soul is punished according to his sin, the wickedness and torments increase with the descent. From the moral pagans of ancient days, who dwell in the highest circle and who sorrow without suffering because they knew not the Christian God, the poet goes down to the foul black abode of brutish crime. The way is so long and steep that only on the back of a monster may he and his guide reach the lowest pit. There lurks infamy so unbelievable that pity for those in eternal torment is turned to loathing. Climbing down the rugged limbs of Satan, who stands at the very bottom like a colossal statue, the two visitors escape through a crevice which leads back to the surface of the earth.

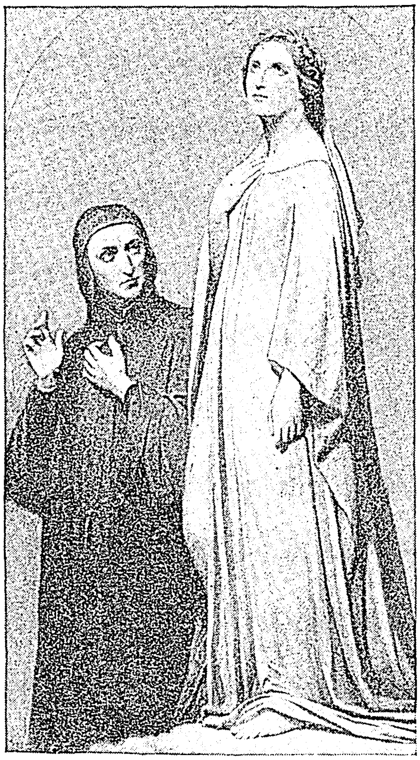
On Easter morning they emerge at a point on the earth's surface opposite to the holy city of Jerusalem—

> Till on our view the beautiful lights of heaven
> Dawned through a circular opening in the cave:
> Thence issuing we again beheld the stars.

Longfellow's translation has this lovely passage:

> The dawn was vanquishing the matin hour
> Which fled before it, so that from afar
> I recognized the trembling of the sea.

DANTE AND BEATRICE



The Italian poet's love was hopeless, because Beatrice was married to another. He cherished it however, and it inspired much of his beautiful poetry.

In the midst of this antipodal ocean stood the mountain of Purgatory—

> The mount that rises highest o'er the wave.

On its seven-terraced slope dwelt the souls of those whose lesser sins might be overcome and atoned for. Rough stairways cut in the rock let the visitors ascend from terrace to terrace, where quiet shades lived in penitence and prayer, to the earthly paradise on the summit.

This was screened by a thick forest which clothed the higher slopes. A serene place of sweetness and peace, there is a charming description of how a light breeze blows through it, turning all the leaves one way, and the gentle rustlings mingled with the songs of the birds.

Like the poet himself the reader is in a state of breathless expectancy. To understand the happiness that awaits him, you should know that in his first book, 'Vita Nuova' (New Life) Dante had celebrated the beauty and virtues and confessed his deathless love for a lady named Beatrice, who had died young. At the end he had expressed the hope that he himself would not die until after he had written of Beatrice such things as had never yet been written of woman.

In the 'Divine Comedy' Dante immortalized the lady of his worship, and set her up above all his desires. In the forest which hid the earthly paradise on the summit of Purgatorio, a sheet of flame suddenly barred his path. When Dante started back in alarm, Vergil had only to whisper that Beatrice waited beyond the fiery wall, and Dante leaped through it. A vision of celestial purity and sweetness, Beatrice appeared, descended from her home in the ninth heaven to be the poet's guide through Paradiso. Taking him by the hand she floated upward with him, "from star to star."

Degrees of Happiness in Dante's Heaven

According to the religious belief of the day, heaven was composed of mounting degrees of bliss, each located on some sphere of the celestial system of which the earth was supposed to be the center. The sun and moon and five of the planets were abodes of the redeemed. As Vergil had led Dante down through the abyss of Hell and up the slopes of Purgatory, so Beatrice transported him through the blue ether and roamed with him over the worlds of ineffable happiness which make up Paradise. As they were rising to the eighth sphere or firmament, the celestial guide bade him cast his view below and look upon the earth:

> Look down, once more, and see how vast a world
> Thou hast already put beneath thy feet.
>
> . . . .
>
> I, with my sight, returned through one and all
> The sevenfold spheres, and I beheld this globe
> Such that I smiled at its ignoble semblance.

In the ninth circle dwelt the hierarchy of angels who guarded and hid the mysteries of the Deity. In a vast amphitheater, whose circles of thrones rose and widened to infinity, sat the souls of those who had died without sin. Here Beatrice left the poet, seating herself remote from him on her own throne—

> . . . . and she so far away
> Smiled, as it seemed, and looked once more at me;
> Then unto the Eternal Fountain turned.

As a mortal visitor Dante might not himself go into the Empyrean, but for a moment his heart was flooded with understanding of the glory of God and the beauty of holiness. The poem ends with these lines of noble submission—

> But yet the will rolled onward, like a wheel
> In even motion, by the love impelled
> That moves the sun in heaven and all the stars.

DANTON (*dän-tôn'*), GEORGES JACQUES (1759–1794). "I am Danton, sufficiently known in the Revolution. I shall soon pass to nothingness, but my name will live in the Pantheon of history." This was the reply of the great leader of the French Revolution when asked his name by the court which condemned him to death.

For two years, 1792–94, he had been guiding and controlling the destinies of France. When the country had been threatened by outside foes, he had aroused his countrymen by his famous cry: "We must dare, and again dare, and dare without end." And, inspired by this bugle-call, they had driven the Austrian invader from their soil. Along with Marat and Camille Desmoulins, Danton had founded the Cordelier's Club, which soon became the rallying-point of all the hotter revolutionists.

The man who thus became the leader of the people of Paris had not an attractive appearance. His face was pitted with smallpox, and he described himself as having "the athletic shape and the stern visage of the Liberty for which he was ready to die."

An able and eloquent lawyer, he was inspired by an ardent patriotism which he managed to communicate to others. Although an extreme republican, he was anxious to keep all Frenchmen working together for the good of the country. When the aristocrats and *émigrés* (emigrant nobles) persisted in opposing the cause to which he devoted his life, he with Marat and Robespierre inaugurated the Reign of Terror, which was carried out by the Revolutionary Tribunal.

When invasion was repelled and royalist uprisings put down, Danton was the first to advocate that the system of Terror be abolished. The need for it was then past, in his opinion. His associate Robespierre, unwilling to sacrifice any of his power for the good of the country, decided that Danton should be brought before the Revolutionary Tribunal and condemned to death. St. Just, a member of the Committee of Public Safety, denounced Danton, and because of the inflamed passions of the time, the great leader's doom was certain.

A friend of Danton's urged him to resist arrest, but he replied: "That means the shedding of blood, and I am sick of it. I would rather be guillotined than guillotine." When urged to flee, he said: "Whither flee? You do not carry your country on the sole of your shoe." Before he was executed he declared, "A year ago I proposed the establishment of the Revolutionary Tribunal. I ask pardon for it, of God and man." His fame remains secure as one of the ablest as well as noblest of the iron leaders of the Revolution which overthrew the old monarchy in France.

DANUBE (*dăn'ūb*) **RIVER.** In a pleasant little valley of the Black Forest—a northern spur of the Alps—a tiny stream comes tumbling down the rocks and, gathering volume and strength from many springs and rivulets, cuts a channel across the sunny slopes and spreading hayfields of south Germany. This little stream, the Brege, with its twin sister, the Brigach, is the source of the Danube, the greatest river of Europe next to the Volga. The Danube has been since earliest history a great water highway, connecting and dividing varied and interesting nationalities, gathering the waters of more than 300 tributaries, and draining one-tenth of Europe in its course of 1,750 miles from the southwest corner of Germany to the Black Sea. A canal 108 miles long binds it to its sister river the Rhine by connecting its tributary the Altmühl with the River Main. So close are the headwaters of the Danube, draining to the Black Sea, to the course of the Rhine, running to the North Sea, that it is often said that the deflection caused by a single pebble might determine the destiny of a raindrop falling on the dividing highlands.

Once a Roman frontier, the Danube through passing centuries has been in turn the highway of westward-moving Huns, Slavs, and Magyars; a barrier and a goal for Russian, Austrian, German, Bulgarian, Turkish, and Rumanian armies, and the channel of eastward- and southward-flowing German culture and influence. Great states, great men, and great cities have flourished on its banks, and the Danube alone remains unchanging and untroubled.

In its course across southern Germany it is not yet the "beautiful blue Danube" of song, but a rushing stream hurrying along among wooded hills and fertile meadows, past picturesque Bavarian towns. At Ratisbon (now called Regensburg) its northernmost point, the Danube is alive with towboats, barges, and rafts busied with the commerce of grain-growing Bavaria. Soon the Bohemian hills edge down the river and deflect its course southeast to Vienna. Then a journey of 30 miles brings one to Bratislava and the edge of the rich plain (Alföld) of Hungary, checkered with growing crops. In fertile valleys white-walled villages shimmer in the sunlight among yellow fields of ripening grain. One now hears the musical Magyar tongue, and sees a new type of face, suggest-

ing a warmer sun, a longer summer, and habitual out-of-door life. After passing through Bratislava, the Danube flows almost 100 miles east into Hungary. Then the river makes a great bend and begins its 500-mile journey into the south.

At Budapest imposing bridges span the Danube's course. Below the city laughing groups of women stand knee-deep in its shallows beating clothes with wooden mallets. Tree-embowered villages nestle long distances apart at the foot of vineyard-clad slopes. Occasionally one passes a group of fishermen's huts and miles of nets drying in the sun. Canals contribute their burden of huge cargoes of grain and lumber from the Hungarian plains. After passing the junction of the eastward-flowing Drava and Sava and the great southward-flowing Theiss with the Danube, one comes to fateful Belgrade, Yugoslavia's capital. Here the mighty river, again heading east, spreads out like a wide lake, with the little white homesteads of the Serbian peasants dotting its shores.

A hundred miles farther on one comes to the black beetling cliffs of the Kazan defile, where the Danube narrows to 160 yards and there is almost twilight gloom. A long gash in the face of the almost perpendicular rock walls tells of the road Trajan's warriors built on the way to found the colony of Dacia, Rumania's ancestor. Just below, the river gathers all its force and batters its way between the Balkan and Carpathian ranges through the historic gorge known as the "Iron Gates" of Orsova. The commercial importance of the Danube necessitated the blasting of a channel here, deep enough to allow river steamers to pass the mile and a half of rapids at all seasons.

As though exhausted by the storming of the Iron Gates, the Danube from Orsova on winds sleepily through a peaceful countryside, separating Rumania from Bulgaria—its monotony broken only by an occasional fishing hamlet or straggling half-Turk, half-Bulgarian, or half-Rumanian town. Beyond Silistria the river turns abruptly to the north, with the swampy Dobruja on the east all the way to the important ports of Braila and Galatz. Here, 125 miles from the mouth, is the head of navigation for seagoing vessels, and so these cities are the shipping centers for agricultural Rumania and other Danubian regions, with docks and grain elevators. Forty-five miles below Galatz, the river divides into three arms which wander across the flat, swampy delta.

What the Danube Means to Europe's Commerce

The Danube not only serves as a channel for local trade among the nations along its banks, but it is also the main route by which the cereals, ores, and oil of southeastern Europe are exchanged for the manufactures of central Europe. It is an avenue of vital importance to Germany. Formerly it was controlled by two international commissions, but in 1940 Germany brought most of the Danubian states into alliance with it and took control of the river. It then set up a new Danube committee, with representatives from these states and Italy, under a German director.

DANZIG (*dän'tsĭk*). This ancient Polish seaport on the Baltic, with its adjoining territory, 754 square miles in all, was taken from Germany by the Treaty of Versailles in 1919. Because it lies at the mouth of Poland's chief river, the Vistula, Danzig was made a "free city" under protection of the League of Nations so that it might serve the revived nation of Poland as a seaport.

But nine-tenths of Danzig's 410,000 inhabitants were German, and Hitler's rise to power in Germany in 1933 gave birth to a strong National Socialist movement in the city. In 1939 Hitler, echoed by Albert Foerster, the Nazi leader in Danzig, demanded the free city's return to Germany. When Poland, backed by England and France, refused to cede Danzig, Hitler on September 1 launched a general war in Europe by sending troops into the city and announcing that henceforth it belonged to Germany. The partition of Poland on September 29 made Danzig formally a part of Germany. (*See also* Europe; Poland.)

Danzig was a German city as far back as 1308, when it was ruled by the Order of Teutonic Knights. Under their sway it became a flourishing commercial city and one of the most important members of the powerful Hanseatic League (*see* Hanseatic League). In 1466 the city was ceded to Poland, but it was returned to Germany by the partition of Poland in 1793. Thenceforth, except for a few years during the Napoleonic wars, it remained German until the end of the World War of 1914–18.

Danzig's medieval glory is stamped on its streets and buildings. In a country almost devoid of stone, Danzig was built of stone, with queer decorations, quaint tile friezes, and rich brass work. St. Mary's Church, the great Gothic cathedral begun in 1343, is one of the largest Protestant churches in the world. The old Crane Tower contains a great treadmill used in the medieval days to transfer grain from the ships into the bins above. Another notable building is the Artushof, which now serves as a grain exchange, but which was built by the merchant princes of the Middle Ages as a clubhouse, with paintings and wood carvings and a torture chamber. Danzig is not only a great shipping port, but also an important manufacturing center with shipyards, foundries, sugar refineries, and flour mills.

DAPHNE (*dăf'nĭ*). One of the beautiful legends of Greek mythology tells of the nymph Daphne, whom Apollo loved. When he descended to earth to woo her, she fled from him, and prayed to her mother Gaea, the earth goddess, to save her. Through the intercession of Gaea, Zeus turned Daphne into a laurel tree. From that time Apollo made the laurel his favorite tree, and its leaves were sacred to him. Winners in the Pythian games, as well as great poets, were honored with a crown of laurel.

Possibly because Daphne's father was a river god, her name, modified to *Daphnia*, has been applied to a genus of minute crustaceans common in ponds and streams. These creatures, also called "water fleas," have birdlike heads, branched antennae, and transparent bivalve shells.

DARDANELLES (*där-dȧ-nĕlz'*). If you wanted to take the world by the throat and choke it into doing your will, one way would be to hold in your power the narrow channel of the Dardanelles, which separates the two mighty continents of Europe and Asia and threatens Africa. Only a little strait, about 42 miles long and from 1 to 5 miles wide, is the Dardanelles, the outer gate to the Black Sea. And yet what a wealth of historical and romantic memories cluster about it—memories of ancient Troy that once dominated its southern entrance; legends of Leander who nightly swam the Hellespont (as the Dardanelles were formerly called) to visit his sweetheart, Hero; memories of the hosts of Xerxes crossing the strait by a bridge of boats in 480 B.C.; and of Alexander the Great, 150 years later, leading an army into Asia by the same way. Every promontory and inlet along these shores has an ancient and thrilling tale to tell.

From the Aegean Sea, the channel of the Dardanelles leads into the landlocked Sea of Marmara. From 1841 for many years, no war vessel was permitted to pass this strait without permission of Turkey. It was Great Britain's policy to keep it under Turkish control in order to bar Russia from the Mediterranean. During the first World War the British, who landed on Gallipoli Peninsula and attempted to force the well-fortified strait, were repulsed with terrific losses. After the war the Dardanelles became part of a neutral "zone of the straits" under the League of Nations. The Treaty of Lausanne (1923) restored the region to Turkey, but a strip on each side of the Dardanelles and the Bosporus was demilitarized. By a treaty made at Montreux, Switzerland, by the powers who had signed the Lausanne Treaty, Turkey in 1936 was again permitted to arm the strait, although provisions were made for its use by other nations.

DARWIN'S *Answer to* NATURE'S GREAT RIDDLE

A YOUNG MAN twenty-two years old set out from England on a sailing vessel for a five-year cruise in strange out-of-the-way places. To most young men it would have been merely a romantic adventure. But to Charles Darwin it was an opportunity to study. He was only twenty-seven when he came back from the cruise but he had gathered in the meantime the material for a scientific theory that was to rock the world. It is interesting to know that Darwin as a schoolboy was thought by his teachers to be somewhat dull and below the average in intellect. Truly he did not possess a quick and brilliant talent. But there is a famous proverb that "genius is the infinite capacity for taking pains." Measured by that definition Darwin was one of the greatest of geniuses.

DARWIN, CHARLES ROBERT (1809–1882). It is a rather remarkable family—two remarkable families, in fact—that Charles Darwin renders illustrious. His father, a successful physician of Shrewsbury, England, was a son of the poet-naturalist, Dr. Erasmus Darwin, and his mother a daughter of the famous potter, Josiah Wedgwood; while Charles' cousin, another grandson of Erasmus Darwin, was Sir Francis Galton, the noted anthropologist.

At school young Charles was considered, he says, "a very ordinary boy, rather below the common standard in intellect." He collected minerals and beetles about as any untaught boy would, "with much zeal but quite unscientifically." The discovery that he "wasted" his time out of school in chemical experiments earned him the nickname of "Gas" from his schoolmates and a severe public reprimand from his schoolmaster.

Two years at Edinburgh University medical school demonstrated that young Darwin was not meant to be a physician, and three happy but aimless and, in his own opinion, unprofitable years at Cambridge University followed as preparation for a clergyman's career. There he came into contact with scientific men, dabbled in entomology, botany, and geology; but he says, "I should have thought myself mad to give up the first days of partridge-shooting for geology or any other science."

Now, within a year of his graduation, occurred the event which was to determine the course of his whole life, namely his appointment as unpaid naturalist to the five-year surveying expedition (December 1831 to October 1836) of the British naval vessel *Beagle* to South American, Australian, and New Zealand coasts and islands. He little guessed, as he gleefully set forth at the age of 22, that he would bring back ideas destined to modify profoundly the whole pattern and fabric of human thought, and make him the most renowned biologist of modern times. During this trip—the only one he ever made out of England—Darwin gathered the enormous amount of scientific data that became the principal foundation for his life's work.

There is a popular misconception that Darwin originated the theory of evolution. This is not the case. Since very early times men had observed that many species of animals and plants resemble one another so closely in structure that they naturally fall into groups or families, such as the cat family, for instance, whose members, from the small common cat to the great lion, have certain "family traits" that distinguish them from all other types of animals. This had led men to wonder if the members of these families might not have sprung from a common ancestor. Nature, they thought, might have brought about gradual changes down through the centuries, producing several species where formerly there had been only one.

This was the germ of the theory of evolution. No one before Darwin, however, had ever attempted to work out a detailed account of *how* nature might have brought about these changes. And while working

out his theory of the *manner* in which species were evolved, Darwin collected and arranged on a scale never before approached the facts on which the general theory of evolution is based. So, while he did not originate the theory of evolution itself, he was responsible for putting the theory into exact scientific form and gaining for it widespread acceptance.

What Lyell's Geology Did for Darwin

When Darwin embarked on H. M. S. *Beagle*, he took with him Lyell's 'Principles of Geology.' Lyell believed that the geological formations of the earth were due to slow changes of a kind that are still in operation, such as erosion by wind and water, the gradual rising and sinking of the earth's crust, etc. Darwin saw that this theory (called "uniformitarianism") would make the earth's history a vastly longer one than had previously been supposed and would provide the time necessary for very slow and gradual changes in the forms of animal and plant life. He was also deeply impressed by the fact that the simpler and more primitive forms of fossils are found in the older strata of the earth, while many of the fossils of the newer strata appear to be more highly developed descendants of the older forms.

During his trip on the *Beagle*, Darwin devoted special study to the animals found on remote islands, particularly the Galapagos Islands, off the west coast of South America. He noticed that the island birds showed marked differences in structure from those of the same species dwelling on the mainland; and this suggested to him that, under the changed conditions of island life, they were on the way to becoming entirely different species. On the mainland he observed that different species of the same family in neighboring districts shaded off into each other, as if they had originally been the same but had been permanently altered by their environment.

Darwin returned to England in 1836 with overflowing notebooks. Incessantly he puzzled over the question of how these variations he had observed might become stereotyped into new species. The clue to the problem came two years later when he read Malthus' 'Essay On Population.' This undertook to show that the human population of the earth always tends to increase faster than the means of subsistence, bringing on a struggle for existence in which many must perish. At once Darwin saw how the principle might apply to the whole world of living things.

Plants and animals are reproduced so rapidly, he reasoned, that there is not room for them all. There is a constant and merciless struggle for existence, in which only a small fraction can survive. But which will survive? Obviously those that are best fitted for the struggle because of some special variation in structure, such as a slightly longer beak in a bird, for instance, or a stronger stem in a plant. The advantageous variation in structure would tend to be handed down from generation to generation, being gradually emphasized and increased until, let us say, the bird's beak had become very much longer or the plant's stem very much stronger—a change in each case sufficient, perhaps, to establish an entirely new species.

This is Darwin's famous theory of *natural selection*, according to which nature produces new species by automatically "selecting" those plants and animals best fitted to live in their various environments. The "survival of the fittest" was the phrase coined later by Herbert Spencer to describe the process.

It took Darwin 20 years of the hardest study and research to develop this theory, which he imparted to only a few friends like Lyell, Sir Joseph Hooker, and the American botanist, Asa Gray. In 1858, while preparing an essay on the subject, he was startled to receive an outline of the same theory from Alfred Russell Wallace. Acting on the advice of his friends, Darwin submitted his own report together with that of Wallace to be read jointly before the Linnean Society. The scrupulous fairness of the two men prevented any rivalry between them and they became the best of friends, each giving full credit to the other.

This first report of the theory by Darwin and Wallace attracted little attention. But when in November 1859 Darwin published his famous book, 'The Origin of Species,' a storm of mingled praise and abuse broke out. The scientific world was chiefly interested in the manner in which the Darwinian theory of natural selection had been worked out. But the startling thing to the rest of the world was the array of arguments in support of the general doctrine of evolution.

Darwinism and the Bible

Many churchmen regarded this doctrine as a dangerous attack upon the biblical account of the creation of the world, especially when it was extended to account for the origin of man. Its assumption that the history of the earth and life upon the earth goes back perhaps millions of years was felt to be irreconcilable with the commonly accepted interpretation of Old Testament chronology, which followed Archbishop Ussher in placing the creation of the world in 4004 B. C. It was also attacked on the score that it belittled and degraded man, and that it was inconsistent with almost every fundamental doctrine of Christianity.

The controversy which then began continues to this day. Evolutionists hold that there is nothing in the theory that conflicts with religion and the Bible. Its opponents declare that evolution and the Bible cannot be brought into harmony, and that if one is true the other must be false. (*See* Evolution.)

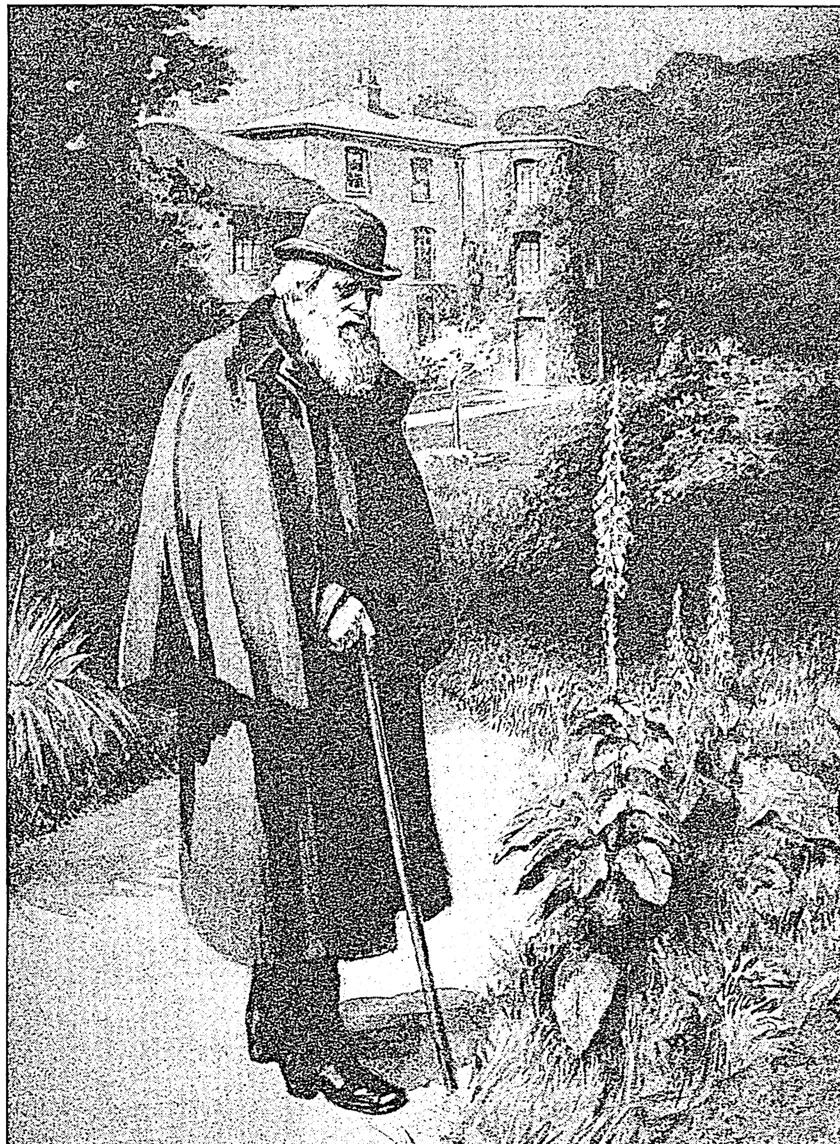
Two volumes, the 'Origin of Species' and the 'Descent of Man', contain the essence of Darwinism, but Darwin's minor contributions to science—on coral reefs, earthworms, climbing plants, etc.—would have been enough to make the reputation of several lesser men. Indeed, the mere amount of his published work is marvelous, considering that "for nearly 40 years he

never knew one day of the health of ordinary men," and was able at best to work only about four or five hours a day. "It's dogged as does it," was a favorite saying of his. "I think doggedness expresses his frame of mind almost better than perseverance," writes his son. "Perseverance seems hardly to express his almost fierce desire to force the truth to reveal itself." In a sense, his great work was a gift to the world from two people—his father, whose sympathetic generosity relieved him of the pressure of financial need; and his wife, who by unremitting loving care enabled him to work without annoyance or interruption.

In showy brilliancy Charles Darwin was altogether lacking. He enumerates his deficiencies—slowness of apprehension, limited ability to follow a long and abstract train of reasoning, hazy memory, awkwardness in expressing himself; and he concludes that his success as a man of science, "whatever this may have amounted to," is due to "complex and diversified mental qualities and conditions," of which the most important were "love of science, unbounded patience in long reflecting over any subject, industry in observing and collecting facts, and a fair share of invention as well as common sense"—a sum which, though he does not say so, adds up to make a genius for synthesis, the greatest in our time and perhaps in any. With characteristic modesty Darwin adds: "With such moderate abilities as I possess, it is truly remarkable that I should have influenced to a considerable extent the belief of scientific men on some important points."

For personal fame Darwin cared little, and this was partly the reason why he never replied to attacks. His generous and kindly nature was evidenced in his relations with other writers, with friends and strangers, and even with animals, whose affection he always won. Cruelty seems to have been almost the only thing that could rouse him to anger. His affectionate sympathy with life extended to all natural things. "I used to like to hear him admire the beauty of a flower," says his son; "it was a kind of gratitude to the flower itself, and a personal love for its delicate form and color." When he died, on April 19, 1882, he was buried with honors among England's greatest in Westminster Abbey.

PONDERING OVER THE "SURVIVAL OF THE FITTEST"

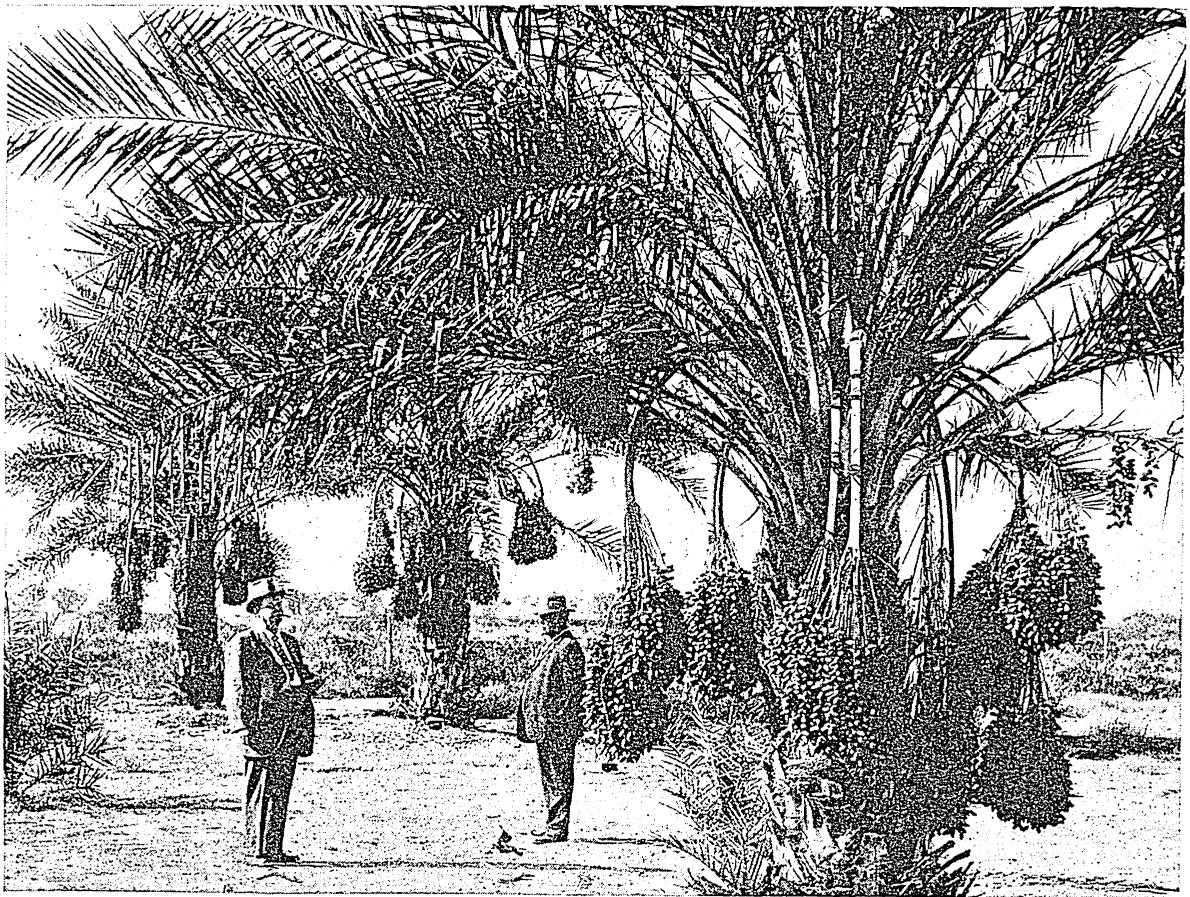


For over 20 years the semi-invalid Charles Darwin patiently collected proofs of his monumental idea concerning the origin of species, testing it at every point by reading, inquiring of naturalists, and watching the plant and animal life about him. As a result, his epoch-making book, 'The Origin of Species', abounds with references to his garden, in which he is here shown taking his morning walk.

Darwin's chief publications were: 'The Journal of a Naturalist' (1839); 'Origin of Species' (1859); 'Descent of Man' (1871); 'Formation of Vegetable Mould through the Action of Earthworms' (1881). His 'Life and Letters', edited by his son Francis Darwin, was published in 1887.

DATE PALM. Four thousand years ago this valuable tree was grown and cultivated along the Euphrates and Tigris rivers. Where it was too hot and too dry for other plants to grow, the date palm flourished, and during all these centuries it has blessed the natives with its fruit, its timber, and its cooling shade, under which they live and mature their orchards and vineyards. Many desert parts of Arabia and the Sahara would not be habitable were it not for this tree which grows in their oases, and which is the most important food plant of the great deserts. Egypt alone has more than 5,000,000 bearing date palms.

A YOUNG ARIZONA DATE ORCHARD



Heavy with fruit, the stems of these young trees hang almost to the ground. When the trees reach their full growth, the clusters may be from 30 to 40 feet above the ground, and the fruit will have to be picked from ladders or from platforms built around the palms.

Not only is this tree remarkable in its power to resist heat and drought, but it can also withstand greater quantities of alkali in the soil than any other useful fruit tree. This has been a vital factor in the development of a date-growing industry in regions of the southwestern United States where the soil is too alkaline to support any ordinary crop. Dates are now being grown successfully in several hot irrigated valleys of California and Arizona, notably in the Imperial Valley of the Salton Basin, in the Coachella Valley (just north of the Imperial Valley), and in the Colorado, Gila, and Salt River valleys of Arizona. Other countries where the date is successfully cultivated are China, Italy, France, and Spain.

The date palm attains a height of almost 100 feet. It has a straight rough trunk which bears its large cluster of leaves and fruit at the top. The leaves are feather-shaped, 12 to 18 feet long, and from 12 to 20 leaves are produced each year. These remain alive and green for several years, but finally lose their color and bend downward toward the trunk, where they are retained in very arid regions. In other regions the leaves finally break off, leaving the trunk rough.

Date palms are divided into male trees bearing staminate blossoms and female trees bearing pistillate blossoms (*see* Flowers). Where they grow in a wild state, the wind must carry the pollen from the male to the female, but, in cultivation, sprays of male blossoms are tied to the female flower clusters.

Each pistillate flower cluster produces a bunch of dates weighing from 10 to 40 pounds, and a vigorous tree is allowed to produce from 8 to 12 such bunches. The tree is grown usually from shoots and begins to bear within four to eight years. It continues to bear

until a century or more old, producing from 60 to 600 pounds of delicious fruit a year. Dates are of very high food value, and are eaten either fresh or dried. The trunk and leaves of the tree furnish the natives with materials for the making of houses and many necessary objects.

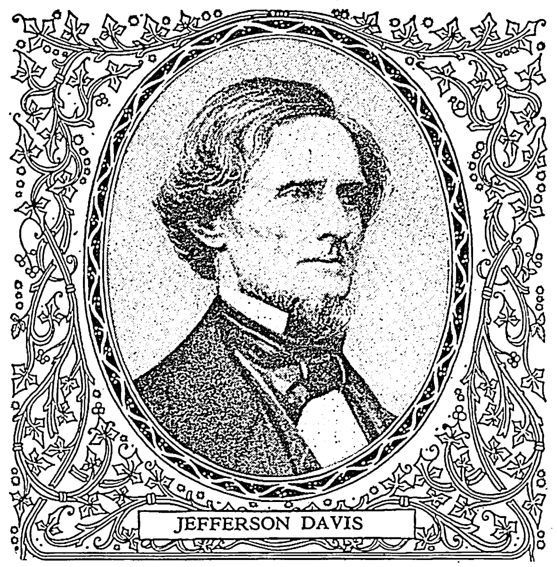
Scientific name, *Phoenix dactylifera*. Trunk rough, straight, unbranched, 60 to 100 feet high. Leaves pinnate, 12 to 18 feet long.

DAVID. The man who has been called "the greatest hero of Israel" began life as a shepherd boy and ended as king (about 1000 B.C.). While tending his sheep he learned to do two things so well that he was later able to be of great service to his king and country. With his harp he soothed King Saul when he was ill, and with his slingshot he killed the Philistine giant Goliath, who for 40 days had dared the Israelites to send forth a champion to fight against him. After his triumph David became King Saul's armor-bearer, and David and the king's son Jonathan were as brothers. Saul grew jealous of David's popularity with the people, and tried to kill him; but David escaped to the cave of Adullam and gathered about him a band of men who attacked enemy tribes, but not Saul's army or their countrymen. Twice David spared the life of Saul; then, in fear of his own life, he left Judah and entered the service of the Philistine king of Gath. When news was brought to David of the tragic death of Saul and Jonathan, in the battle of Gilboa, he grieved greatly, saying, "I am distressed for thee, my brother Jonathan; very pleasant hast thou been unto me: thy love to me was wonderful, passing the love of women."

David was made king of Judah, following Saul's death, and later of united Israel. He freed the land from the Philistines, and conquered the Canaanite tribes about Jerusalem and made that city his capital. He became the most powerful king between the Nile and the Euphrates; but his last years were troubled by the revolt and death of his son Absalom.

David was a brave warrior, beloved by his men, and a wise king. He is said to have written the Psalms which are given in the Bible. He made the plans for the beautiful temple which his son Solomon was to build. Thus he was not merely a warrior and statesman, but also a poet, musician, and architect as well.

DAVIS, JEFFERSON (1808–1889). The frontier state of Kentucky, strangely enough, in the short space of seven months saw the birth of Abraham Lincoln, the war-time president of the United States, and Jefferson Davis, the first and only president of the Confederate States of America. While the boys were still young, both families left Kentucky, the Davis family going to the slave state of Mississippi, the Lincoln family to the free state of Indiana and later to Illinois. While Lincoln was splitting rails in the frontier wilderness and studying borrowed books at night by the light of the open fire, Davis—who was a few months the elder—was getting a good education in the academies of Mississippi and Kentucky, and later at Transylvania University, Lexington, Ky. Before he had finished his course at Transylvania University, he secured an appointment to the military academy at West Point, from which he was graduated in 1828. He then learned something of frontier life, as a young officer at the little military post of Prairie du Chien, Wis. During the Black Hawk War Davis, as an officer in the regular army, served in northern Illinois, and at the same time and in the same region, Abraham Lincoln, as captain of a company of volunteers, helped drive the Indians across the Mississippi.



JEFFERSON DAVIS

In 1835, Davis, tiring of army life, resigned his commission, and returned to his old home in Mississippi. There he became a plantation owner and acquired considerable wealth before he entered upon his political career, in 1845, as a Democratic member of Congress. When he made his first speech in that body the venerable John Quincy Adams is said to have exclaimed, "That young man will yet make his mark in American history." At the outbreak of the Mexican War next year, Davis resigned his seat to become a colonel of Mississippi volunteers. He served with distinction under his father-in-law, Gen. Zachary Taylor, being severely wounded in the battle of Buena Vista.

As soon as he returned to civil life Colonel Davis was sent by Mississippi to the United States Senate, where he succeeded to the position of leader held by the aged Calhoun. With Calhoun he opposed the Compromise of 1850. He resigned his seat in 1851 to become an unsuccessful candidate for the governorship of his state; while upholding the right of secession as a last resort he held that circumstances did not yet justify it. In 1853 he became Secretary of War under Franklin Pierce as president, and as such improved the nation's military equipment and enlarged the army which was later to be used so effectively against the seceding states.

At the expiration of Pierce's term, he returned to the United States Senate, where he continued to serve until his state left the Union. In the campaign of 1860 it was his insistence that the Democrats adopt a pro-slavery platform that split the party and permitted the election of Lincoln, the Republican candidate. In the Senate he now upheld not only the right but the necessity of secession, and when Mississippi left the Union he bade farewell to his associates in a speech of exceptional power and left Washington.

Characteristics as President of the Confederacy

Davis hoped to become the commander of the Confederate forces in the field, but instead (February 1861) he was elected president of the newly formed Confederacy. To him was given the difficult task of guiding the new government during the terrible war which followed secession. His people had no army, no navy, and limited resources. He must provide all three. For a time it seemed that he would succeed, and that the Confederacy would become one of the family of nations. His people were united in thought and feeling, and at first Davis' administration was highly popular. But as time brought military reverses, criticism began. Now Davis, who in the United States Senate had stood for the rights of the states, learned by experience that a war could not be successfully waged if each state were going to do as it pleased. Consequently he began to take more and more power into his own hands, until even his own officials at Richmond complained that there was more personal freedom under Lincoln's government.

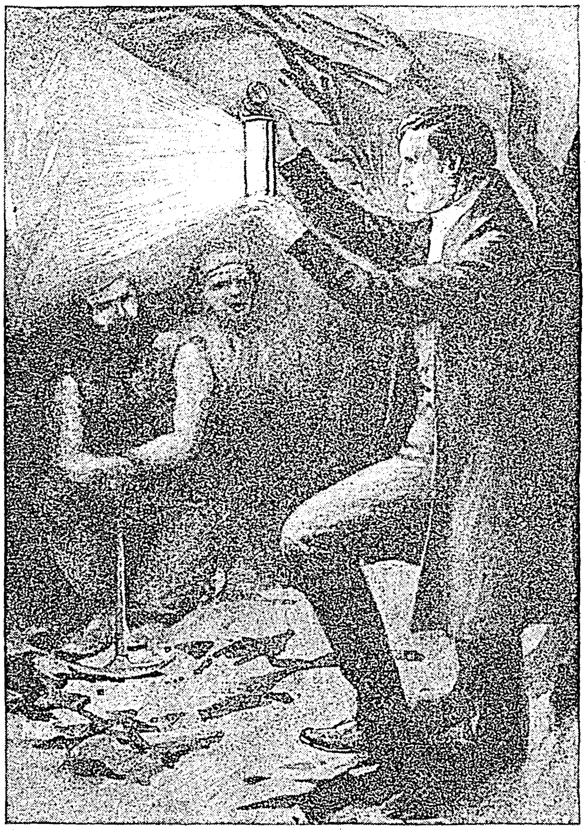
President Davis was not indifferent to the personal liberty of his people, nor forgetful of their rights as individuals, but he was dictatorial in manner. His experience, both as an officer in the army and as a slaveholder, had developed in him self-confidence and habits of command which made it almost difficult for him to conciliate those with whom he differed. On the whole, however, he made few blunders and in the midst of hostile criticism he continued to work with zeal and energy for the Southern cause.

But finally as the blockade of the coasts of the South threw the people more and more on their own resources, and as these resources grew less and less, the struggle became hopeless. Still Davis was unwilling to give up. In his last message, dated March 13, 1865, he declared that in spite of reverses, success might yet be secured. In less than 30 days after this General Lee surrendered at Appomattox Court House; and in a short time the fugitive President Davis was captured by United States troops near Irwinsville, Ga.

For a time Davis was confined at Fortress Monroe, and his sufferings there aroused the sympathy of the Southern people. Even those who had found fault with him now regarded him as a martyr to their cause; he who had been an autocrat became an emblem of the "Lost Cause," which was still sacred to them. After two years' imprisonment, he was released on bail, Horace Greeley and other prominent Northern men becoming his bondsmen. As soon as he regained his liberty he journeyed to Canada and Europe in a vain attempt to regain his shattered health. Upon his return to the United States he tried to retrieve his broken fortunes. But the business ventures upon which he embarked proved failures, and in 1878 he retired from active life. The rest of his days were spent upon his book 'The Rise and Fall of the Confederate Government'. He died in New Orleans, in 1889, but his body was later removed to the old Confederate capital, Richmond, Va. A monument now stands in Richmond to the memory of "Jefferson Davis, the first and only President of the Confederate States of America"; and another to his daughter "Winnie Davis, the Daughter of the Confederacy."

DAVY, SIR HUMPHRY (1778–1829). As a boy in Penzance, Cornwall, Davy gave little promise of his

"THE MINER'S FRIEND" TESTING HIS LAMP



Although he was famous for many discoveries, Sir Humphry Davy is best remembered for his invention of the safety lamp, which cut down tremendously the number of deadly explosions in mines.

future gifts as one of England's greatest scientists. His tastes were for making verse translations of the classics and for story-telling, rather than for science. It was not until his father died in 1794 that he set to work along the lines that brought him fame. As assistant to a surgeon apothecary, he read widely in metaphysics, ethics, mathematics, and then passed on to chemistry. All this work was done before he was 19, in preparation for the study of medicine. But his

work in research soon made him too valuable a man for any medical career. Thomas Beddoes, a prominent scientist, made him superintendent of his experimental laboratory, and there he discovered the properties of laughing-gas (nitrous oxide).

Davy's published articles on oxygen and nitrous oxide brought him fame. In 1801, before he was 23, he was engaged as assistant lecturer in chemistry and director of the laboratory at the new Royal Institution, and ten weeks later he became professor there. Using a powerful galvanic battery he isolated sodium and potassium, and proved them elements. He made special studies of tanning and agricultural chemistry. His studies in electricity were so remarkable that in 1808, though England and France were at war, Napoleon gave him the medal for the year's best experiment in galvanism. In 1812 he was knighted, and in 1820 he was made president of the Royal Society of England. His lectures drew great crowds. Some went because of his profound learning; some because of his fame; some because of his great gift of putting difficult theories in clear, simple words. Coleridge, the poet, declared he went "in order to increase his stock of metaphors." But Davy modestly declared that his greatest discovery was his assistant, Michael Faraday. (*See* Faraday, Michael.)

Davy's name will always be associated with his safety lamp for miners in which the flame was screened by wire gauze so that not enough heat could pass through to set the surrounding gases afire.

DAWES, CHARLES GATES (born 1865). His energetic and paradoxical personality made Charles G. Dawes one of the best-known Americans of his time. Though he held the rank of brigadier general in the first World War, Dawes was the most unmilitary of men. On one occasion he roared at a congressman, "Don't call me 'general'!" He piled up a large personal fortune, chiefly as a banker, but kept alive his love for music and wrote a charming melody for the violin. Belligerent and blunt, yet shyly tender-hearted toward the under-dog, Dawes established several hotels in which the unfortunate find lodgings at nominal charges, with no prying questions asked.

Dawes was born in Marietta, Ohio, in 1865, a descendant of the William Dawes who rode with Paul Revere. He worked his way through Marietta College and through the Cincinnati Law School, then began to practise law in Lincoln, Neb. In 1894 he wrote his authoritative 'Banking System of the United States'.

Abandoning the law, he entered business, starting the Northwestern Gas Light & Coke Company, in Evanston, Ill. He was active in the nomination of President McKinley and was appointed comptroller of the currency of the United States by him in 1898.

Dawes went to France in 1917 as major of engineers, and during 1918–19, as brigadier general, he supervised the purchase of supplies for the American forces, and was a member of the military board of allied supply. As first director of the budget in 1921–22, he cut the year's expenses of the nation by $1,600,000,000. As chairman of the Expert Committee on Reparations he worked out the famous "Dawes Plan" adopted in 1924 (*see* World War). In 1924 he was elected vice-president of the United States. From 1929 to 1932 he was ambassador to Great Britain.

DAY. Where did our week days get their names? Sunday is the sun's day; Monday the moon's day; Tuesday the day of Tiw or Tyr, Teutonic war god; Wednesday the day of Woden or Odin, chief Teutonic god; Thursday the day of Thor, Teutonic thunder god; Friday the day of Frigga or Frigg, Woden's wife and goddess of marriage; Saturday the day of Saturn, Roman god of agriculture.

How long is a day? A "solar," or sun, day is the time required for the earth to make one rotation, as measured from one noon to another (passage of the sun over the meridian line). It varies in length because the earth's position shifts as it revolves around the sun. Only four times a year is the actual solar day exactly the same length as our "mean" or average solar day of 24 hours. Most accurate is the "sidereal," or star, day, the interval between two consecutive appearances of a fixed star on the meridian. It is about four minutes shorter than the mean solar day, so there are 366 sidereal days in a year of 365 solar days. (*See* Calendar; Equinox and Solstice; Time.)

At the Equator day and night are each always twelve hours long, while north and south of the Equator the length of the day varies (*see* Earth). From March 21 to September 23 the North Pole has a six months' day, the South Pole a six months' night; from September 23 to March 21 the conditions are reversed.

Primitive people usually reckoned a day from sunrise to sunset. Some religious sects today still observe their Sabbath as from one sundown to another. As civilization advanced, however, such division was not considered precise enough. A natural day includes the 24 hours from midnight to midnight. The Roman civil day, still prevailing in most countries today, also changes at midnight. "Days of grace" are extra days allowed for paying a note or other legal obligation, after the date of its maturity.

DAYLIGHT SAVING TIME. An amusing article on the advantages of setting the clock ahead to provide more waking hours of daylight was written by Benjamin Franklin in 1784. Serious consideration was given to the idea in a movement started by William Willett in England in 1907. But it was not until the World War of 1914–1918 that "daylight saving" or "summer" time was adopted in the United States and other countries. The general practise is to keep clocks one hour ahead of standard time in spring and summer. During the second World War some countries kept the clock two hours ahead the year around. The United States went on "war time" (one hour ahead) on Feb. 9, 1942. Farmers dislike the change, since farm work goes by the sun rather than by the clock. But in cities the advantages are great. Not only is there more time for outdoor recreation or work, but there is a considerable saving in electricity and fuel.

DAYTON, OHIO. When a group of Revolutionary War veterans founded Dayton in 1796, they endowed it with the energetic pioneer spirit that has ever marked its history. It has been a city of bold attempts and successful experiments.

Dayton straddles the Miami River, in southwestern Ohio, at the point where it is joined by the Mad and the Stillwater rivers. In 1913 the three rivers, swollen by heavy rains, swept down on the city with great loss of life and property. The citizens had hardly dug out of the mud before plans were under way to prevent another such disaster. Within a few years the Miami Valley Conservancy District, at a cost of more than $30,000,000, had built five dams and retarding basins, which are still a model for flood prevention programs.

In 1913 Dayton became the first large city to adopt the city-manager form of government. In 1925 a ten-year city development plan was launched. Slums were razed, streets widened, new public buildings erected, and railroad tracks elevated.

Aviation history has been made in Dayton. Here the Wright brothers built the airplanes in which they made the world's first flights. Their experimental field is now part of Wright Field, where the United States Army Air Corps tests new planes and equipment. There is also a large municipal airport.

The manufactures are mostly precision products requiring highly skilled labor. Dayton's cash registers and computing scales, electric refrigerators, electric-lighting and water plants for home use, and airplane parts are distributed throughout the world. All the United States government's stamped envelopes are made here.

Dayton was chartered as a city in 1841. It has an art institute, a Catholic university, and two theological seminaries. Population (1940 census), 210,718.

DEAF, EDUCATION OF. Until recent times, the so-called "deaf and dumb" were considered burdens to society. They were thought to be hopelessly dull because they could not communicate with others. Even as late as the 18th century, the common law of England presumed them to be little more than idiots.

But today we know that most deaf children have normal intelligence and can be trained by special methods to take useful places in society. The development of these special methods is one of the most interesting chapters in the history of education.

The first to establish a school for the deaf was the Abbé Charles-Michel de l'Épée (1712–1789), who devised the first finger alphabet. He opened his school about 1760 at Paris. The next step was the development of methods to train deaf children to *speak*. Nearly all so-called "deaf-mutes" have voices. But they need special training to develop the power of speech, because they cannot learn to speak by the normal method of imitating others. Thomas Braidwood, a Scottish teacher who opened a school for the deaf at London in 1783, is said to have taught speech, but little is known about his methods.

The 19th century brought notable advances. The deaf were trained both to speak and to understand others by watching the motions of their lips. A great aid was "visible speech," invented by A. Melville Bell, of Edinburgh. "Visible speech" consists of alphabetical characters showing the position of the vocal organs for each speech sound.

Education of the Deaf in the United States

The earliest schools for the deaf in the United States used the sign method rather than the oral, or speech, method. America's first permanent school for the deaf was founded in 1817 at Hartford, Conn., by Thomas H. Gallaudet, the father of deaf-mute education in America. Gallaudet College (founded 1864), at Washington, D. C., the world's only institution for higher education of the deaf, is named in his honor.

America's first school to use the oral method was the Clarke School for the Deaf, established at Northampton, Mass., in 1867. In 1871, Alexander Graham Bell introduced his father's system of "visible speech" to the United States (*see* Bell, Alexander Graham). In 1887, he endowed at Washington, D. C., the Volta Bureau for the Increase and Diffusion of Knowledge Relating to the Deaf. This bureau supplies information on all matters relating to the deaf, except medical or surgical treatment.

Most of the deaf in the United States are now taught by the oral method. Children who have not been born deaf but who have lost their hearing in early childhood are relatively easy to teach, if they have learned to speak before their hearing was impaired. Those who are born not only deaf but blind present a special problem (*see* Blind, Education of).

DEATH VALLEY, CALIF. So barren and parched is this white desert strip of southern California, near the Nevada border, that it does indeed seem as though the hand of death had touched it. In the gold rush of 1849 a band of pioneers struggled through it after infinite suffering and gave the cruel valley its sinister name. The valley is a deep trough between the Panamint Mountains on the west and the Grapevine, Funeral, and Black mountains on the east. It is about 130 miles long and 10 to 35 miles wide. Four hundred square miles of its area lie below sea level, and it contains the lowest point of dry land in the country, 280 feet below sea level. Only 86 miles from this spot towers Mount Whitney, the highest peak in the United States. Despite the scorching heat, which has reached a record of 134°, more than 500 kinds of plants exist there, as well as rattlesnakes, lizards, and other animals. The average annual rainfall is less than an inch and a half. Water piped from warm springs in the mountains irrigates the only ranch, where dates and alfalfa grow. At most times the bed of the Amargosa River is only a series of dry channels. White salts, mostly borax, thickly crust great areas of the soil. These once provided nearly all the country's domestic borax. Two-thirds of the valley was made a national monument in 1933, and tourists now crowd the hotels in winter.

DECA'TUR, STEPHEN (1779–1820). "The most daring act of the age," said Lord Nelson, the famous British admiral, of Lieutenant Decatur's exploit in Tripoli harbor, on the night of Feb. 16, 1804. Pirates from the Barbary States had captured the United States frigate *Philadelphia* and taken it into Tripoli harbor, and Stephen Decatur, with a small ship and a small crew, slipped into the harbor, fired the *Philadelphia*, and escaped under the fire of 114 guns without the loss of a man. This deed made Decatur a captain in the United States Navy.

These pirates from the shores of Morocco, Algeria, Tunis, and Tripoli, had for centuries been the terror of the Mediterranean, preying on Christian commerce and capturing Christians as slaves. It was Decatur who gave them their first lesson in law, one which was completed in 1815, when he returned with an American fleet and forced them to respect the American flag.

Almost from the day he was born, at Sinnepuxent, Md., Decatur had been acquainted with the sea, for his father also was a sailor. He became a midshipman at 19, a lieutenant at 20, and his men were proud to call him captain at 25. In the War of 1812 he captured the British frigate *Macedonian* after a desperate fight. Later in the war he was surrounded by four English frigates and after being twice wounded himself and losing one-fourth of his men was compelled to surrender his ship.

At the height of his popularity Commodore Decatur, as he had then become, was killed in a duel with Commodore James Barron. He has well been called "the most conspicuous figure in the naval history of the United States for the 100 years between Paul Jones and Farragut." His best remembered saying is the toast which he once gave: "My country —may she ever be right, but right or wrong, my country"!

DECEMBER. When the old Roman calendar began with March, December was indeed the *tenth* month, as its name indicates (from the Latin *decem*, "ten"), but Julius Caesar made it the twelfth when he changed the time for the beginning of the year. It is preëminently the winter month, for in it comes the winter solstice, December 21 or 22 (*see* Equinox and Solstice).

LEARNING DECIMALS *by the Mile*

DECIMALS. You know that an automobile has a speedometer on its instrument board which looks like Fig. 1. The dial at the top indicates the speed, the left-hand dial registers season mileage, and the right-hand one indicates trip mileage. As the car travels, the rotating wheels of the speedometer cause figures to appear on the lower dials to indicate the distance traveled. There are ten figures or digits on each wheel, thus:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

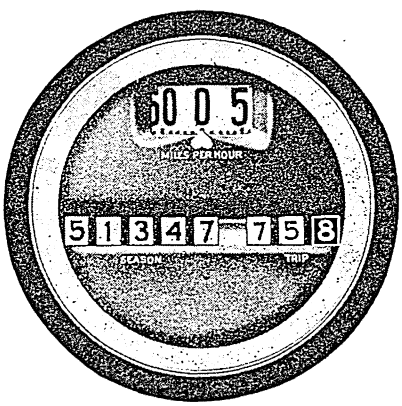


Fig. 1

When the trip mileage dial reads as in Fig. 1, the automobile has traveled more than 75 miles. What does the right-hand figure, 8 in this case, signify?

If we observe closely as we ride, we shall notice that ten changes occur in the right-hand figure for every mile traveled, thus: 75.0, 75.1, 75.2, 75.3, 75.4, etc., to the end of the mile. Each change in the reading, therefore, indicates one-tenth of a mile. 75.9 means $75\frac{9}{10}$, 76.0 means 76 even, 76.1 means $76\frac{1}{10}$. In other words, we have here an illustration of the *decimal system* of writing fractions, which uses a period called the *decimal point* to separate the fraction from the whole number. The only denominations used in this system are *tenths, hundredths, thousandths,* and other powers of one-tenth. The denominator of the fraction is indicated by the position of the decimal point. Thus .1, .2, .3, etc., are always read "one-tenth," "two-tenths," "three-tenths," etc.

The convenience of this system will appear in the fact that adding, subtracting, multiplying, and dividing fractions may be performed as with whole numbers, provided the decimal point is properly handled. Since the only denominations used are tenths, hundredths, etc., fractions with other denominators must be reduced to these denominations by methods to be illustrated later.

Let us see how decimal calculations are made.

ADDITION—

1. What is the distance from Waukesha, Wis., to Oconomowoc if it is 10.8 miles to Delafield, 4.4 miles from that place to Summit Corners, and 3.0 miles farther still to Oconomowoc? From Fig. 2 you can see at a glance that to solve the problem we must add the three numbers.

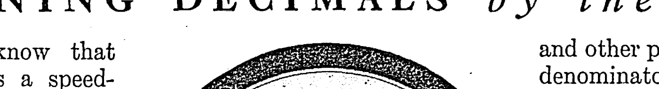


Fig. 2

Solution:

$$\begin{array}{r} 10.8 \\ 4.4 \\ 3.0 \\ \hline 18.2 \end{array}$$

Answer: The distance is 18.2 miles.

Since 10.8 = 108 tenths, 4.4 = 44 tenths, and 3.0 = 30 tenths, it is plain that the sum is 182 tenths, or 18.2, and that such numbers may be added like whole numbers, if the decimal point is properly placed.

2. On the Boston and Maine Railroad it is 3.4 miles from Boston to Cambridge, 6.5 miles farther to Waltham, 3.3 miles more to Kendal Green, 3.5 miles from Kendal Green to Lincoln, while Concord is 3.4 miles beyond Lincoln. How far is Concord from Boston? (Fig. 3.)

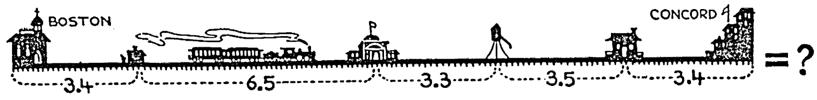


Fig. 3

Solution:

3.4
6.5
3.3
3.5
3.4
20.1

Answer: Concord is 20.1 miles from Boston.

3. A boy taking a bicycle trip in the suburbs of Chicago rides west from Evanston 7.8 miles, then turns north on Milwaukee Avenue .3 miles, and then rides westward 2.4 miles to the end of Ballard Road, and .6 miles beyond to a bridge over the Desplaines River. How far does he ride? (*See* Fig. 4.)

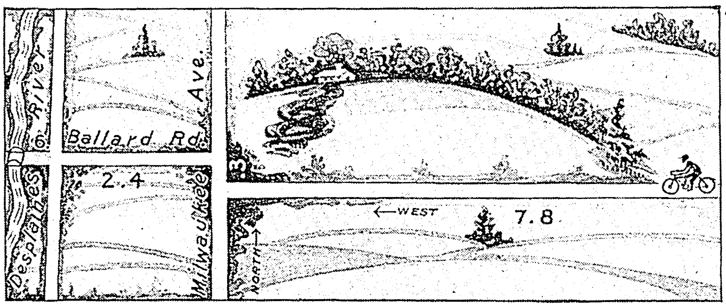


Fig. 4

Solution:

7.8
.3
2.4
.6
11.1

Answer: He rides 11.1 miles.

4. The speedometer shows the distance from Glencoe, Ill., to Wheeling to be 7.8 miles, Wheeling to Buffalo Grove 4.0 miles, Buffalo Grove to Long Grove 2.5 miles. How far is it from Glencoe to Long Grove? See if you can find the answer.

Subtraction—

1. The speedometer shows the distance from Milwaukee to Brookfield to be 13.1 miles, and at Waukesha it registers 16.8 miles. How far is Waukesha from Brookfield?

Solution:

16.8
13.1
3.7

Answer: The distance is 3.7 miles.

2. West Bend is 33.7 miles from Milwaukee, Kewaskum 45.4 miles. How far from West Bend to Kewaskum?

Solution:

45.4
33.7
11.7

Answer: The distance is 11.7 miles.

3. A car leaves Boston with the dial set at 00.0. At Fitchburg it registers 49.6, at Gardner 64.7, and at Hoosac Tunnel, 135.0. How far is it from Fitchburg to Gardner? Gardner to Hoosac Tunnel? Fitchburg to Hoosac Tunnel?

Solutions:

64.7	135.0	135.0
49.6	64.7	49.6
15.1	70.3	85.4

Multiplication—

1. A motorcycle runs 9 times around a track .8 of a mile in circumference. What is the total distance that it travels? *See* sketch below (Fig. 5).

Solution:

.8
9
7.2

Answer: It travels 7.2 miles.

Since .8 = 8 tenths, the product is 72 tenths or 7.2.

2. A taxicab travels from Buffalo to Tonawanda and back three times (6 times 10.4 miles). How far has it traveled?

Solution:

10.4
6
62.4

Answer: It traveled 62.4 miles altogether.

Division (*Measure* or *Comparison*)—

1. The round trip from M— to R— and back is 4.8 miles. How many round trips make 24 miles?

Solution: $4.8\overline{)\,24.0}$ = 5; 24.0

Proof: 5×4.8 = 24.0. In other words, 48 tenths are contained in 240 tenths 5 times.

2. Smith's automobile can run only 9.5 miles on one gallon of gasoline. He proposes to run from Concord, N. H., to Boston by a route which he knows to be 76 miles long. How many gallons of gasoline will he use?

Solution: $9.5\overline{)\,76.0}$ = 8; 76.0

Answer: He will use 8 gallons.

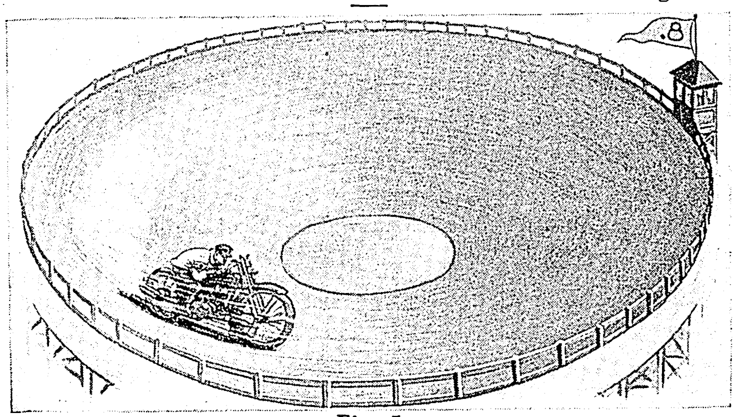


Fig. 5

Division (*Partition*)—

1. It is 55.2 miles from Washington to Harper's Ferry. What is $\frac{1}{3}$ of this distance?

Solution: $3\overline{)\,55.2}$ = 18.4

Proof: 3 × 18.4 = 55.2.

2. Find $\frac{1}{5}$ of 48.

Solution: $5\overline{)\,48.0}$ = 9.6

Proof: 5 × 9.6 = 48.

3. A farmer proposes to divide an 18-acre field into 4 equal fields. How many acres would each smaller field contain? Fig. 6 shows you the answer. If he should divide the 18-acre field into *five* equal fields, how much would each contain? Can you work it out?

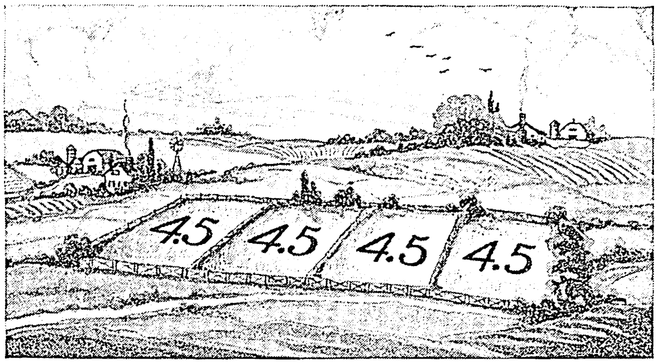


Fig. 6

Problems Involving Hundredths

So far, the only fractions we have used are tenths. Now let us go a step farther and see how hundredths are handled.

(a) One dollar = 100 cents; therefore one cent = $\frac{1}{100}$ of a dollar.

(b) One dime = $\frac{1}{10}$ of one dollar.

(c) One cent = $\frac{1}{10}$ of one dime = $\frac{1}{10}$ of $\frac{1}{10}$ of one dollar = $\frac{1}{100}$ of one dollar.

(d) (Read just as you read "c.") One cent = .1 of one dime = .1 of .1 of one dollar = .01 of one dollar (written $.01).

(e) $.17 is 17 hundredths of one dollar; $.39 is 39 hundredths of one dollar.

(f) $7.25 may be read 7 and 25 hundredths dollars. Read the following in the same way: $4.33; $2.15; $.34; $.20.

ADDITION—

How far is Poughkeepsie from New York if it is 14.49 miles to Yonkers, 10.03 miles farther to Tarrytown, and 48.24 miles from Tarrytown to Poughkeepsie?

Solution:
```
 14.49
 10.03
 48.24
 -----
 72.76
```
Answer: The distance is 72.76 miles.

An important point to bear in mind when *adding* or *subtracting* decimals is that the numbers must be written so that the decimal points fall in a column. This brings units under units, tenths under tenths, hundredths under hundredths, etc.

SUBTRACTION—

The distance from New York to Yonkers is 14.49 miles; from New York to Albany, 142.20 miles. How far is it from Yonkers to Albany?

Solution:
```
 142.20
  14.49
 ------
 127.71
```
Answer: The distance is 127.71 miles.

MULTIPLICATION—

Find the frontage (length of front line) of 8 lots lying in a row, if each is 25.44 feet wide.

Solution:
```
 25.44
     8
 ------
 203.52
```
Answer: The total frontage is 203.52 feet.

DIVISION—

Poughkeepsie is 72.76 miles from New York. If I want to walk the distance in four days, how far must I travel each day, on the average?

Solution:
```
     18.19
 4.) 72.76
```
Answer: $\frac{1}{4}$ × 72.76 (read "$\frac{1}{4}$ of 72.76") = 18.19.

Decimal Quotients

Examples:

1. 6 = what part of 8?

Sometimes we find what part one number is of another by division, thus:

```
     .75
 8) 6.00
```
Answer: 6 = .75 × 8. (Six equals 75 hundredths of 8.) In such a case the sign × should be read "*of*," not "*times*," or "*multiplied by*."

Verification: Draw a line 8 in. long. Divide it into parts 2 in. long; 2 in. = $\frac{1}{4}$ of 8 in.; 6 in. = $\frac{3}{4}$ of 8 in.; but $\frac{3}{4}$ of 1 = $\frac{3}{4}$ of 1.00 = .75; so 6 = .75 of 8.

2. A two-foot rule folds in 6-inch lengths. What decimal part of the whole 24 inches is 1 length or 6 inches? (*See* Fig. 7.)

Solution:
```
      .25
 24) 6.00
     4 8
     ----
     1 20
     1 20
```
Answer: 6 = .25 × 24 (read the sign × as "of").
Proof: This answer is evidently right, as 6 = $\frac{1}{4}$×24 and .25 = $\frac{25}{100}$ = $\frac{1}{4}$.

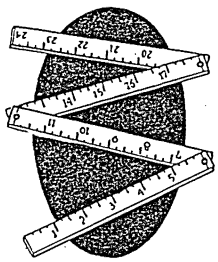


Fig. 7

Principle. To find what decimal part one integer is of another, divide the number regarded as a part by the one regarded as the standard or whole. Annex zeros to the dividend, set them off by a decimal point, divide as in whole numbers. Point off as many figures in the quotient as there were zeros annexed to the dividend. Sometimes the quotient must be carried out more than two decimal places, as illustrated below.

Example: 7 ft. = what part of 56 ft.?

Solution:
```
      .125
 56) 7.000
     5 6
     ----
     1 40
     1 12
     ----
       280
       280
```
Answer: 7 = .125×56 (7 = 125 thousandths of 56).

Sometimes the division will not come out even, no matter how far the quotient is carried, as illustrated below.

1. 8 miles = what part of 24 miles?

Solution:
```
      .333+
 24) 8.000
     7 2
     ---
       80
       72
       --
       80
       72
```
Here we may write as answer: 8 = .333+ of 24, or 8 = .33$\frac{1}{3}$ × 24.

2. 3 miles is what part of 21 miles?

Solution:

```
        .1428 +
 21 ) 3.0000
      2 1
        90
        84
         60
         42
         180
         168
          12
```

Answer: 3 = .1428+ of 21 (3 = 1428 ten-thousandths of 21).

In this case the answer is not exact. We call it approximate. As many decimal places as desired can be used. For ordinary purposes two or three will suffice. The plus sign indicates that the answer is only approximate.

Decimal Multipliers

1. Find .5 of 92. This means $\frac{5}{10}$ of 92 or $\frac{1}{2}$ of 92.

Solution:

```
   92
   .5
 46.0
```

Answer: .5×92 = 46 (read "five-tenths *of* 92 = 46").

Proof: When 46 is divided by 92, the quotient is .5.

Or .1 of 92 = $\frac{1}{10}$ of 92 = 9.2.

.5 of 92 = 5×9.2 = 46.0.

```
       .5
 92) 46.0
```

2. Find .5 of 16 ft.

Solution:

```
  16
  .5
 8.0
```

Answer: .5 of 16 ft. = 8 ft.

3. Find .3 of 16; .7 of 16; .9 of 16.

4. Find .25 of 24.

Solution:

```
   24
  .25
 1 20
 4 8
 6.00
```

Answer: .25 of 24 = 6.00 = 6.

5. Find .37 of $250.

Solution:

```
  $250
   .37
 17 50
 75 0
$92.50
```

Answer: .37 of $250 = $92.50.

Multiplying by a decimal fraction should be conceived as finding a fraction of the multiplicand.

Decimal Multipliers and Decimal Multiplicands

(a) $\frac{1}{10}\times\frac{1}{10}=\frac{1}{100}$ (read the sign × as *"of,"* not *"times"*).

(b) $\frac{3}{10}\times\frac{2}{10}=\frac{6}{100}$.

(c) .3×.2 = .06.

From these examples we get the principle that any number of tenths multiplied by any number of tenths = some number of hundredths.

(a) $\frac{1}{10}\times\frac{1}{100}=\frac{1}{1000}$ (read $\frac{1}{10}$ of $\frac{1}{100}$).

(b) .1×.01 = .001.

(c) .01×.1 = .001.

Thus we see that any number of tenths multiplied by any number of hundredths = some number of thousandths.

Principle. Place the decimal point in any decimal product so as to set off as many figures to the right of it as there are to the right of the decimal point in the multiplier plus the number in the multiplicand.

Example: How many inches in 3.2 meters? (1 meter = 39.37 inches.)

Solution:

```
   39.37
     3.2
   7 874
  118 11
 125.984
```

Answer: 3.2 meters = 125.984 inches.

Multiply as if there were no decimal points, then place the point between the 5 and the 9 of the product. There are two figures to the right of the point in the multiplicand and one in the multiplier, so there must be three to the right in the product.

Decimal Quotients and Decimal Divisors

Example: 3.6 is what part of 7.2?

Solution:

```
         .5
 7.2 ) 3.60
       3 60
```

Answer: 3.6 is .5×7.2 (.5 of 7.2).

Add a zero to the dividend and divide exactly as in whole numbers. There should be one place in the quotient, because if 7.2 were multiplied by the quotient .5, the product would be 3.60, a number with two decimal figures to the right of the point. Hence the multiplier must have had one decimal place since the multiplicand 7.2 had but one. A convenient method in dividing by decimals is to move the decimal point to the right in the divisor to make it a whole number. Move the decimal point in the dividend the same number of places to the right, adding zeros if necessary.

Finding the Number of Which a Given Number is a Given Part

1. 9 = .5 of what number?

Solution:

```
       1 8
 .5 ) 9.0
```

Answer: 9 is .5 of 18.

Proof:

```
  18
  .5
 9.0
```

.5 of 18 = 9.0.

2. 9 = .75 of what number?

Solution:

```
         12
 .75 ) 9.00
```

Answer: 12 is the number.

3. 8.5 = .17 of what number?

Solution:

```
         50
 .17 ) 8.50
```

Answer: 8.5 is .17 of 50.

Principle. When dividend and divisor have the same number of decimal places (to the right of the point), the quotient is a whole number.

Decimal Equivalents for Fractions

It is convenient to know the following decimal equivalents for the fractions used most commonly:

$\frac{1}{2}$ = .5	$\frac{3}{5}$ = .6	$\frac{7}{8}$ = .875	$\frac{1}{9}$ = $.11\frac{1}{9}$
$\frac{1}{4}$ = .25	$\frac{4}{5}$ = .8	$\frac{1}{3}$ = $.33\frac{1}{3}$	$\frac{1}{11}$ = $.09\frac{1}{11}$
$\frac{3}{4}$ = .75	$\frac{1}{8}$ = .125	$\frac{2}{3}$ = $.66\frac{2}{3}$	$\frac{1}{12}$ = $.08\frac{1}{3}$
$\frac{1}{5}$ = .2	$\frac{3}{8}$ = .375	$\frac{1}{6}$ = $.16\frac{2}{3}$	$\frac{1}{20}$ = .05
$\frac{2}{5}$ = .4	$\frac{5}{8}$ = .625	$\frac{5}{6}$ = $.83\frac{1}{3}$	$\frac{1}{25}$ = .04

To reduce a *common fraction* to a *decimal*, annex as many zeros to the numerator as necessary, and divide by the denominator. Thus: $\frac{3}{16}$ = 3.000÷16, or .1875. To reduce a *decimal* to a *common fraction*, write the decimal with its denominator and reduce it to its lowest terms. Thus: .12 = $\frac{12}{100}$ or $\frac{3}{25}$.

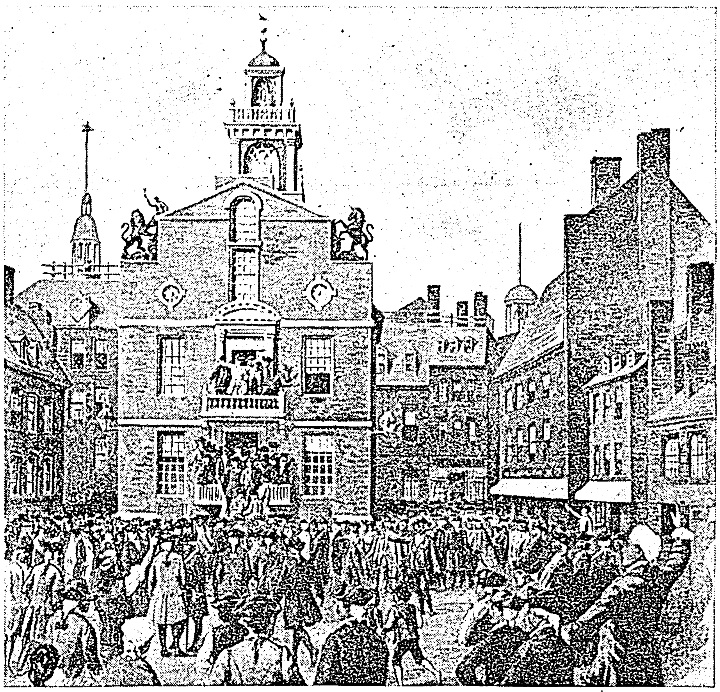
Decimals as we know them were not used until the latter part of the 16th century, after Simon Stevinus (1548–1620) a mathematician, physicist, and engineer of Bruges, had devised and published a system. The "decimal point" is said to have been invented by Bartholomaeus Pitiscus in 1612 and was used by Napier in his logarithms. Since then the use of decimals has grown continuously.

When LIBERTY *was* FIRST PROCLAIMED

How the Demand for American Independence Rose to a Great Cry—How Jefferson Put that Cry into Immortal Words—And How Roaring Cannon and Racing Horsemen Carried Afar the Message of the Liberty Bell

DECLARATION OF INDEPENDENCE. "Yesterday the greatest question was decided which ever was debated in America, and a greater, perhaps, never was nor will be decided among men." Thus John Adams wrote to his wife after the Continental Congress had voted independence on July 2, 1776, in the State House at Philadelphia. Two days later Congress adopted the Declaration of Independence, explaining and supporting the act. Adams and others had long desired to take this step; but most of the colonists had hoped to remain in the British Empire, with a larger measure of self-government. In June 1775, Washington promised to use every exertion to restore "peace and harmony between the mother country and the colonies"; and as late as September of that year Jefferson said that he "looked with fondness towards a reconciliation."

BOSTON RECEIVES THE TIDINGS OF LIBERTY



The news of the Declaration of Independence aroused great enthusiasm everywhere. Here we see the excited crowd listening while it is being read from the steps of the Old State House in Boston.

Even so, however, most of the colonists wanted their rights of self-government more than the benefits of the British Empire. As the year 1775 wore on, it became painfully clear that the two could no longer go hand in hand. Parliament would not repeal the "five intolerable acts" or admit that only the local assemblies could tax the colonists. In August, the king called the patriots "rebels," and summoned all British subjects to aid in bringing them to terms. In December he removed the colonies from his protection and blockaded their ports. In effect, then, the king had begun war almost a year before the Declaration was adopted. Its ravages were making the people more and more bitter. The British in October 1775 burned the town of Portland, Me., destroying the homes of a thousand people just at the approach of winter. The siege of Boston inflicted severe hardships on the inhabitants there. Then came news that 20,000 Hessian (German) troops had been hired to put down the revolt. "The king," wrote Jefferson, "has plundered our seas, ravaged our coasts, burnt our towns, and destroyed our people." The German mercenaries were intended "to complete his works of death, desolation, and tyranny." On the frontiers he had aroused against the settlers "the merciless Indian savages, whose known rule of warfare" was the destruction of defenseless women and children.

If the colonists had to preserve their rights by fighting, then they had to have the means of making war, and trading with other nations. But they could not secure aid abroad so long as they were subjects of King George, nor could they make a treaty of commerce with a foreign state. First they must declare themselves independent.

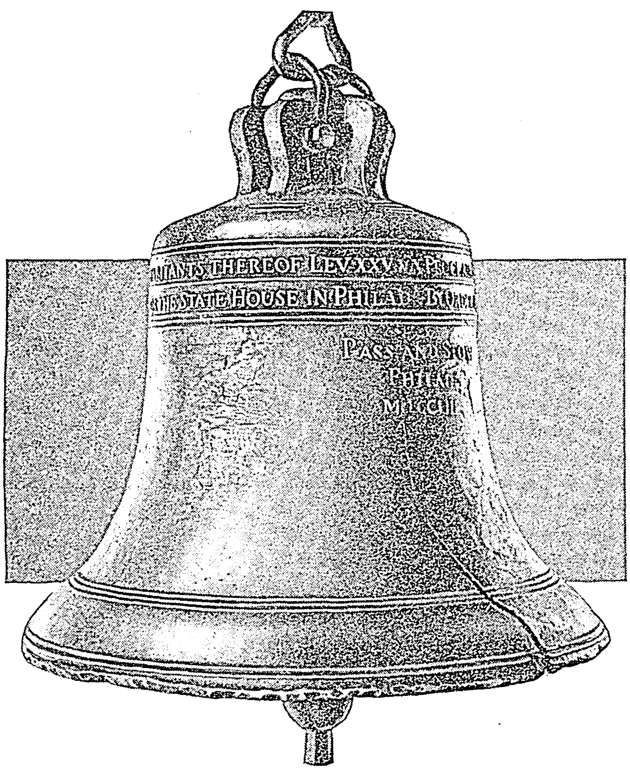
The time was ripe. In January 1776 a vigorous pamphlet, 'Common Sense', came from the pen of a radical, Thomas Paine, who had recently come from England. How, he asked, could the people longer fight against the king and profess their loyalty to him? The day of compromise had passed. "The blood of the slain, the weeping voice of Nature cries, 'Tis time

to part'." Here is the vast continent of North America, suited to become the home of a race of free men; let it no longer lie at the feet of an unworthy king. Thousands of men read this rousing challenge and accepted the idea of complete separation as inevitable.

In the spring of 1776 several states—North Carolina taking the lead—directed their delegates in Congress to declare for independence. Virginia requested hers to make the necessary motion. Accordingly, one of her spokesmen, Richard Henry Lee, introduced on June 7, 1776, a resolution which declared that "these United Colonies are, and of right ought to be, Free and Independent States, that they are absolved from all allegiance to the British Crown, and that all political connection between them and Great Britain is and ought to be totally dissolved."

Since not all the states had yet told their delegates to vote for separation, this resolution was not immediately adopted. But a committee of five—John Adams, Thomas Jefferson, Benjamin Franklin, Roger Sherman, and Robert Livingston—was appointed to prepare a statement of the American case. Jefferson was chosen to draw up this declaration, for he had already won renown as a skilful and persuasive writer. He presented a rough draft to Adams and Franklin, who suggested minor changes. Then the corrected paper was brought into Congress on June 28. On July 2, the Lee resolution was adopted. Jefferson's Declaration was debated until July 4, when it was adopted by Congress, with some modifications. Contrary to early tradition, the signing of the Declaration did not take place on that day. On July 19 a copy was ordered engrossed on parchment. This document was submitted to Congress on August 2, and signed on that date by the members present. Members who were absent signed later at various times.

THE VOICE OF LIBERTY



On the famous Liberty Bell, under the biblical quotation concerning freedom, are inscribed the names of the men who recast it—Pass and Stow—the abbreviation Phila., and the date of its casting, 1753.

Origin of the Declaration

Jefferson put little that was new into this famous document—the birth certificate of the United States. Its ideas were the meat and drink of America at the time. They had previously been popular in England; John Locke had used them in his widely read book, 'Of Civil Government', in defense of the English Revolution of 1689. Nor did the Declaration actually establish the independence of the United States; it merely stated an intention and the cause for action. It must be converted into fact by force. But once adopted, there was no turning back.

The Declaration is a statement of the American theory of government and an explanation of the Revolution. God had made all men equal and had given them the rights of life, liberty, and the pursuit of happiness. The main business of government was to protect these rights. If instead it tried to take them from the people, they were free to discard it and to set up a new one in its place. These ideas formed the groundwork of the new state governments erected after the Declaration was adopted.

Abuses Charged Against the King

Who had deprived the colonists of their natural rights? Not Parliament, but the king. Every abuse complained of was laid at his door. He had never given America her rights; the people had always been free, acknowledging him only while he treated them fairly. But now, by a long series of usurpations, he had tried to make them slaves. He had signed the unpopular acts of Parliament with that intent. Twenty-seven specific wrongs had he committed, and Jefferson recited them.

The colonists took this stand of protest against the king because, if they acknowledged the authority of Parliament, they could not easily refuse to abide by its laws. They could, however, recognize the king as a past symbol of their kinship with England without conceding that he had ever had any real power. Moreover, if the Declaration had attacked Parliament, it would have attacked the representatives of the British people. Thus, it would have blunted sympathy among the English for the American cause. The king had powerful enemies at home who would be inclined to help the colonists if it was felt that they were fighting solely against him. To foreigners the Revolution would not seem to be a revolt against an unquestioned authority—only a defense of rights long enjoyed and impossible to relinquish.

According to report, when the Declaration was accepted on July 4, the Liberty Bell, hanging in the belfry of the old Pennsylvania State House, now known as Independence Hall, first proclaimed the news to the people of Philadelphia. The firing of cannon and racing horsemen carried the tidings far and wide. Washington had the Declaration read to his army, and its ringing sentences strengthened the morale of the troops. The patriots everywhere now had a close-up picture of a single foe. America's grievances were no longer intangible laws, but the misdeeds of a man of flesh and blood.

The Liberty Bell, brought from London in 1752, has, cast upon it, the prophetic inscripture: "Proclaim liberty throughout the land unto all the inhabitants thereof." On July 8, 1776, this bell again fulfilled its purpose by summoning the inhabitants of the city to listen to the reading of the Declaration. Each year thereafter it brought together the people to celebrate the anniversary of the Declaration of Independence, until in 1835 it cracked while tolling for the funeral of John Marshall, the celebrated chief justice of the Supreme Court.

It has since remained in the hallway of the old State House of Philadelphia, an object of veneration. It was lightly struck by officers of the city on April 6, 1917, when the United States entered the war with Germany.

Today the engrossed copy of the Declaration, faded and almost illegible, is kept in a shrine of glass and marble in the Library of Congress.

*Text of the Declaration of Independence**

In CONGRESS, July 4, 1776.

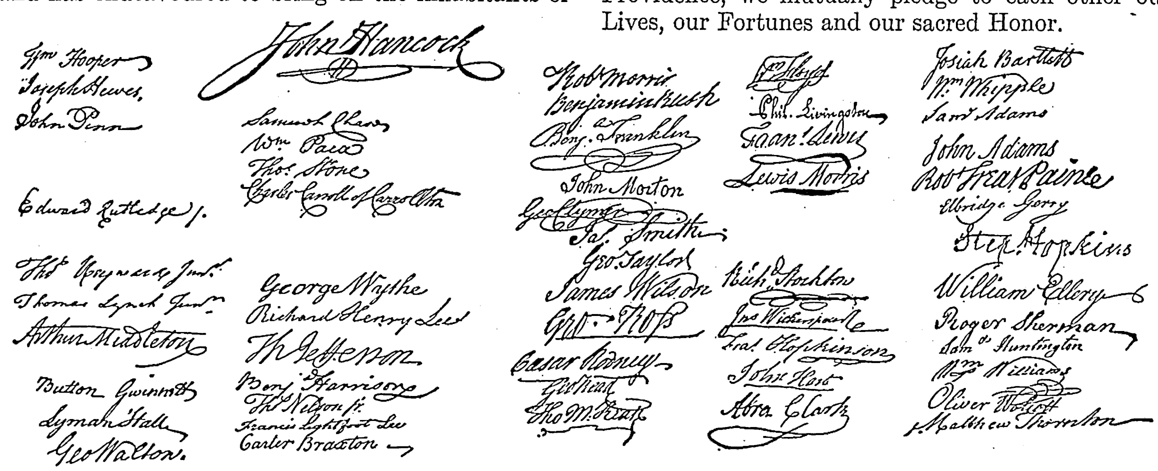
The unanimous Declaration of the thirteen united States of America,

WHEN in the Course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation.——We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.——That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed, ——That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness. Prudence, indeed, will dictate that Governments long established should not be changed for light and transient causes; and accordingly all experience hath shewn, that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, pursuing invariably the same Object evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government, and to provide new Guards for their future security.——Such has been the patient sufferance of these Colonies; and such is now the necessity which constrains them to alter their former Systems of Government. The history of the present King of Great Britain is a history of repeated injuries and usurpations, all having in direct object the establishment of an absolute Tyranny over these States. To prove this, let Facts be submitted to a candid world.——He has refused his Assent to Laws, the most wholesome and necessary for the public good.——He has forbidden his Governors to pass Laws of immediate and pressing importance, unless suspended in their operation till his Assent should be obtained; and when so suspended, he has utterly neglected to attend to them.——He has refused to pass other Laws for the accommodation of large districts of people, unless these people would relinquish the right of Representation in the Legislature, a right inestimable to them and formidable to tyrants only.——He has called together legislative bodies at places unusual, uncomfortable, and distant from the depository of their public Records, for the sole purpose of fatiguing them into compliance with his measures.——He has dissolved Representative Houses repeatedly, for opposing with manly firmness his invasions on the rights of the people.——He has refused for a long time, after such dissolutions, to cause others to be elected; whereby the Legislative powers, incapable of Annihilation, have returned to the People at large for their exercise; the State remaining in the mean time exposed to all the dangers of invasion from without, and convulsions within.——He has endeavoured to prevent the population of these States; for that purpose obstructing the Laws for Naturalization of Foreigners; refusing to pass others to encourage their migrations hither, and raising the conditions of new Appropriations of Lands.——He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing Judiciary powers.——He has made Judges dependent on his Will alone, for the tenure of their offices, and the amount and payment of their salaries.——He has erected a multitude of New Offices, and sent hither swarms of Officers to harass our people, and eat out their substance.——He

*This text follows exactly the spelling and punctuation of the original document.

has kept among us, in times of peace, Standing Armies without the Consent of our legislatures.——He has affected to render the Military independent of and superior to the Civil power.——He has combined with others to subject us to a jurisdiction foreign to our constitution, and unacknowledged by our laws; giving his Assent to their Acts of pretended Legislation: —For quartering large bodies of armed troops among us:—For protecting them, by a mock Trial, from punishment for any Murders which they should commit on the Inhabitants of these States:—For cutting off our Trade with all parts of the world:—For imposing Taxes on us without our Consent:—For depriving us in many cases, of the benefits of Trial by Jury:—For transporting us beyond Seas to be tried for pretended offences:—For abolishing the free System of English Laws in a neighbouring Province, establishing therein an Arbitrary government, and enlarging its Boundaries so as to render it at once an example and fit instrument for introducing the same absolute rule into these Colonies:——For taking away our Charters, abolishing our most valuable Laws, and altering fundamentally the Forms of our Governments:—For suspending our own Legislatures and declaring themselves invested with power to legislate for us in all cases whatsoever.—He has abdicated Government here, by declaring us out of his Protection and waging War against us.——He has plundered our seas, ravaged our Coasts, burnt our towns, and destroyed the lives of our people.——He is at this time transporting large Armies of foreign Mercenaries to compleat the works of death, desolation and tyranny, already begun with circumstances of Cruelty & perfidy scarcely paralleled in the most barbarous ages, and totally unworthy the Head of a civilized nation.—— He has constrained our fellow Citizens taken Captive on the high Seas to bear Arms against their Country, to become the executioners of their friends and Brethren, or to fall themselves by their Hands.—— He has excited domestic insurrections amongst us, and has endeavoured to bring on the inhabitants of our frontiers, the merciless Indian Savages, whose known rule of warfare, is an undistinguished destruction of all ages, sexes and conditions. In every stage of these Oppressions We have Petitioned for Redress in the most humble terms: Our repeated Petitions have been answered only by repeated injury. A Prince, whose character is thus marked by every act which may define a Tyrant, is unfit to be the ruler of a free people. Nor have We been wanting in attentions to our Brittish brethren. We have warned them from time to time of attempts by their legislature to extend an unwarrantable jurisdiction over us. We have reminded them of the circumstances of our emigration and settlement here. We have appealed to their native justice and magnanimity, and we have conjured them by the ties of our common kindred to disavow these usurpations, which, would inevitably interrupt our connections and correspondence They too have been deaf to the voice of justice and of consanguinity. We must, therefore, acquiesce in the necessity, which denounces our Separation, and hold them, as we hold the rest of mankind, Enemies in War, in Peace Friends.——

We, therefore, the Representatives of the united States of America, in General Congress, Assembled, appealing to the Supreme Judge of the world for the rectitude of our intentions, do, in the Name, and by Authority of the good People of these Colonies, solemnly publish and declare, That these United Colonies are, and of Right ought to be Free and Independent States; that they are Absolved from all Allegiance to the British Crown, and that all political connection between them and the State of Great Britain, is and ought to be totally dissolved; and that as Free and Independent States, they have full Power to levy War, conclude Peace, contract Alliances, establish Commerce, and to do all other Acts and Things which Independent States may of right do.——And for the support of this Declaration, with a firm reliance on the protection of divine Providence, we mutually pledge to each other our Lives, our Fortunes and our sacred Honor.



[This is an exact copy of the signatures as they appear in the original document, except for the last three signatures in the first column. In the original, these appear by themselves in an additional column at the left, thus bringing the name of John Hancock in the center of the page. Their position has been changed above for the sake of convenience.]

How NATIONS *Honor Heroes of* PEACE *and* WAR

DECORATIONS AND TITLES OF HONOR. In feudal days the man who led troops to victory was given a title and a rank in the royal court, just as in the modern army the general or colonel has a rank which gives him authority over other soldiers. Orders of honor were also established, some of which carried rank and others merely titles.

Today all great nations reward special valor and patriotic service with decorations of honor.

United States Medal of Honor

In the United States the highest award is the Medal of Honor. Because it is given by the president in the name of Congress, it is often called the "Congressional Medal." There are separate designs for Army and Navy, but the rules governing the award are the same.

A Medal of Honor may be given to anyone in the Army or Navy who, "in action involving actual contact with the enemy, distinguishes himself conspicuously by gallantry and intrepidity, at the risk of his life, *above and beyond the call of duty.*"

That last phrase in the law should be noted, for an act of courage, no matter how great, performed in the course of carrying out orders or as a part of a man's service duties, does not merit a Medal of Honor. The act must be entirely voluntary and beyond anything that might be expected.

In time of war the president may confer upon the highest commanders in the field the power to award this medal. Also Congress may vote a Medal of Honor to persons not ordinarily eligible. The award to Charles A. Lindbergh for his pioneer flight to Paris is an example.

Other Army, Navy, and Marine Decorations

The second most important decoration in the United States Army is the Distinguished Service Cross, awarded to any person serving with the Army "who distinguishes himself or herself by extraordinary heroism in connection with military operations against an armed enemy." Next in rank is the Distinguished Service Medal for Army men who perform "exceptionally meritorious service to the Government in a duty of great responsibility." This is a reward for men in administrative posts in peace as well as in war.

The fourth ranking American medal, authorized in October 1942, is the Legion of Merit. It is awarded to members of the armed forces of the United States and the Philippines who have distinguished themselves by exceptionally meritorious conduct in the performance of outstanding services.

The Silver Star is awarded to each soldier who is commended for gallantry in orders published by his commanding general. The Soldier's Medal is for heroism that does not involve conflict with the enemy.

In the Navy, the Navy Cross corresponds to the Army's Distinguished Service Cross. The Distinguished Service Medal and the Silver Star also correspond to the Army awards. The Brevet Medal is a special Marine Corps award for bravery in action. The Navy and Marine Corps Medal is awarded for heroism not involving actual conflict with an enemy. The Purple Heart is awarded for "singularly meritorious acts" in any of the armed services; it goes also to those who have been honorably wounded in action.

Army or Navy aviators may receive either of two medals. One is the Distinguished Flying Cross, awarded "for heroism or extraordinary achievement while participating in aerial flight." The other is the Air Medal, given for "meritorious achievement."

A 1919 ruling prohibits a man's being awarded any of these decorations more than once. Instead, when he merits the award again, the Army gives an Oak Leaf Cluster, and the Navy a Gold Star, to be worn on the ribbon of the original decoration.

All the decorations mentioned above, with the exception of the Medal of Honor (Congressional Medal), may also be awarded to members of the armed forces of foreign countries.

American Service Medals

In addition to these decorations of honor, the United States, prior to its entry into the second World War, issued Service Medals to all officers and enlisted men who have served honorably in its various wars and campaigns, as follows:

Army Service Medals—Civil War, Indian Campaign, Spanish Campaign, Spanish War (non-fighting service), Cuban Occupation, Puerto Rican Occupation, Philippine Campaign, Philippines Congressional (McKinley Medal), China Campaign, Cuban Pacification, Mexican Service, Mexican Border, and Victory Medal (World War of 1914–18).

Navy and Marine Corps Medals—Civil War, Spanish Campaign, Philippine Campaign, China Relief Expedition, Cuban Pacification, Nicaraguan Campaign, Mexican Service, Haitian Campaign, Dominican Campaign, Victory Medal, Second Nicaraguan Campaign, and Yangtze Service.

Other Navy awards—Expeditionary Medals for service in Panama, Korea, and Abyssinia; medals commemorating the battle of Manila Bay and naval engagements in the West Indies; Specially Meritorious Medal; Good Conduct Medals: and the Naval Reserve Medal for ten or more years' service.

When American forces began to participate in the military engagements of the second World War, additional campaign medals were authorized. These were awarded to members of the land and naval forces of the United States who served outside the continental limits of the country in the various "theaters" of war. The earlier medals were given to American servicemen who took part in the invasions of North Africa, Sicily, and Italy, or who fought against the Japanese in the Aleutian Islands and the Southwest Pacific.

Decorations and service medals are worn only on occasions of ceremony. At other times medals are represented by some device, such as a rosette or a ribbon called a "service ribbon."

The Victory Medal was awarded to all who served in the American Army, the Navy, or the Marine Corps between April 6, 1917, when war was declared against Germany, and Nov. 11, 1918, the date of the armistice, and to those who served in the later campaigns

in Russia and Siberia. For civilian dress, Victory buttons are worn on the lapel.

Battle clasps worn on the ribbon of the Victory Medal were awarded to all who took part in any one of the following battles: Cambrai, Somme defensive, Lys, Aisne, Montdidier-Noyon, Champagne-Marne, Aisne-Marne, Somme offensive, Oise-Aisne, Ypres-Lys, St. Mihiel, Meuse-Argonne, and Vittoria-Veneto (Italy). Those who served in the front lines, but did not take part in any of the battles named, may wear a clasp marked "Defensive Sector." Those who saw service abroad, but not in the front lines, are entitled to a clasp naming the country where they served. The Navy has similar clasps indicating the nature of service performed.

Before the Silver Star was originated, an officer or enlisted man who was cited for bravery wore a silver star on the ribbon of his service medal. The Silver Star now replaces this decoration.

Since the proclamation of a national emergency Sept. 8, 1939, the president has awarded the Medal for Merit to civilians of the United States, of the United Nations, and of other friendly foreign nations who have "distinguished themselves by exceptionally meritorious conduct in the performance of outstanding services." Another civilian award, created since the beginning of the second World War, is the Merchant Marine Distinguished Service Medal.

Britain's Victoria Cross

The highest honor that the British fighting man can win is the Victoria Cross, established by Queen Victoria in 1856. It may be awarded to men of all ranks in the army and navy—including, since 1912, native officers and men of the Indian army—but only for a signal act of conspicuous bravery in the presence of the enemy. So high is the standard set for the "V.C.," as it is called, that during the first 50 years less than 600 were issued, although Great Britain fought many campaigns, including the Boer War.

The Distinguished Service Order (D.S.O.) is given to British army and navy officers for conspicuous merit in time of war, including heroism under fire or other important services in the field. It was founded in 1886. It illustrates a type of distinction in which the receiver of the award becomes a member of an honorary *order*, or society. The Distinguished Conduct Medal, given to noncommissioned officers and men in the ranks, corresponds to the D.S.O. of commissioned officers.

In the second World War, Canada established an award of its own, called the Canada Medal. This was given to civilians and members of the armed forces "for meritorious service above and beyond the faithful performance of duties."

Several British decorations were created during the World War of 1914–1918: the Military Cross, for commissioned and warrant officers below the rank of major; the Military Medal, for non-commissioned officers and civilians for acts of bravery in the field; the Distinguished Service Cross and the Distinguished Service Medal, both naval decorations.

France's Legion of Honor

Membership in the French Legion of Honor, one of the most famous of all distinctions, is awarded for meritorious service to France in military or civil life. A scientist may receive the decoration for some valuable discovery, or a soldier for an act of conspicuous bravery. The order was founded by Napoleon in 1802, and includes the following ranks: Knights of the Grand Cross (20), Grand Officers (50), Commanders (250), Officers (2,000), and Knights or Chevaliers (12,000 maximum). Membership may be conferred upon foreigners as well as Frenchmen, and upon women as well as men. The French Croix de Guerre, established during the first World War, and the Médaille Militaire, founded by Napoleon III, are the two most noted decorations for purely military services.

Decorations of Other Countries

Germany's highest military decorations are the Order for Merit (*Ordre pour le Mérite*), instituted in 1665, and the Iron Cross, instituted in 1813. The Iron Cross was so freely bestowed during the World War of 1914–1918 that it lost some of its value. But during the second World War the Nazi government restored it as a mark of extraordinary military distinction.

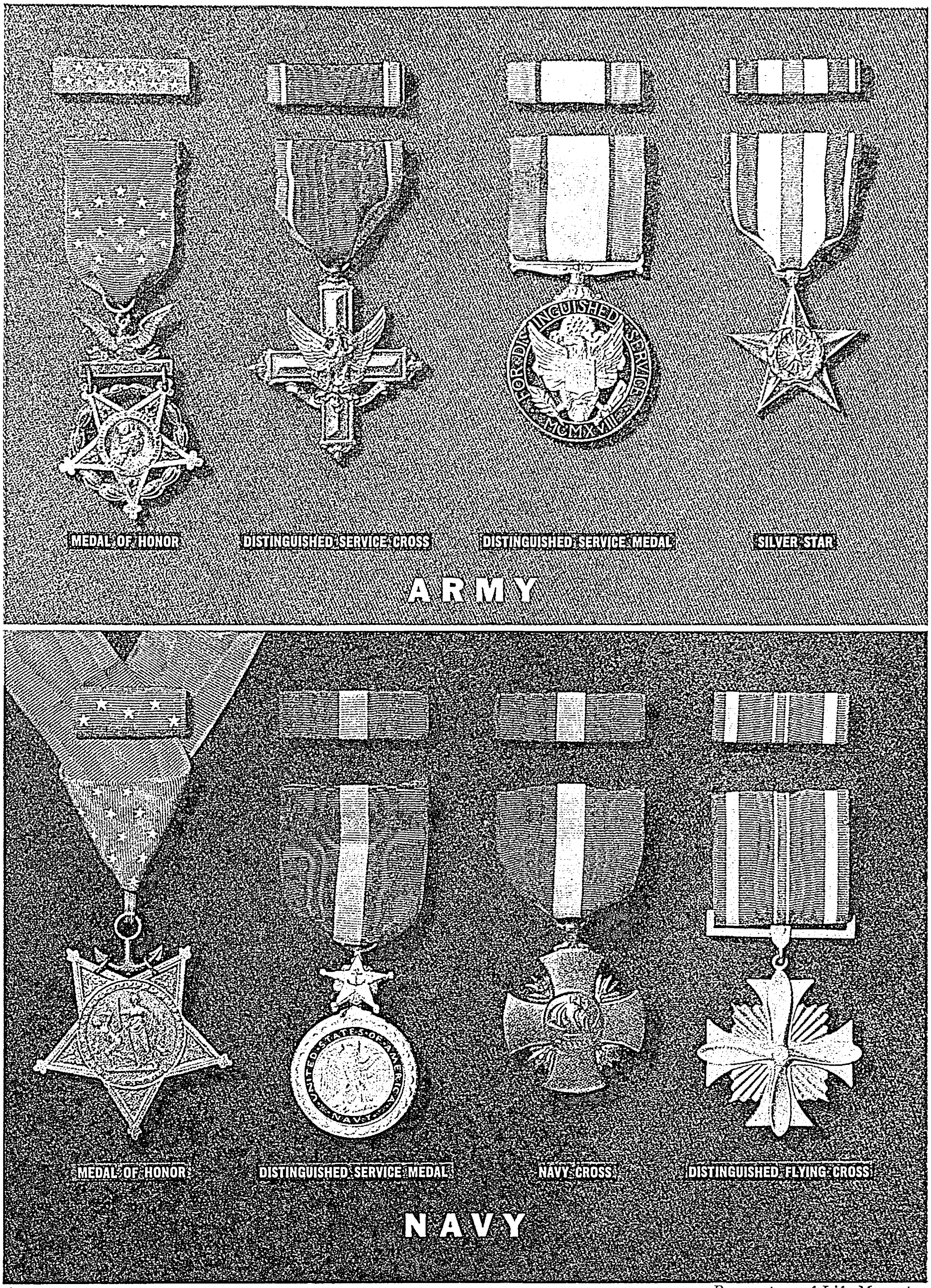
The chief Italian decoration is the Military Order of Savoy. In Belgium the highest distinctions are the Order of Leopold and the Military Cross.

Titles of Nobility and What They Stand For

TITLES of nobility date back to feudal days, but they do not mean the same as they did then. Today they indicate the social rank of a person whereas in the old days of knights and ladies, they were the marks of responsibility. The man who had a title had duties to perform, and held his rank in court because of that. (*See* Feudalism.)

At first the only titles were count and duke. "Count" comes from the Latin word *comes* which means a companion of the king. "Duke" comes from the Latin word *dux*, a leader. The dukes were in charge of sections of the country or parts of the army, and had to lead their armies in battle. The counts were the chiefs of sections of the country, such as provinces in France or counties in England. These titles came to mean the right to rule a part of the country, and they were hereditary, passing from father to son. Thus they became titles of nobility. "Comes" and "dux" (the Latin forms of these words) were used by Charlemagne. When his empire broke up, the titles survived in different parts of Europe, finally in France becoming "conte" and "duc" and in Germany "graf."

When the Normans conquered England, they divided the country and entrusted the administration of the counties to "earls," who were of the same



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By courtesy of Life Magazine

UNITED STATES DECORATIONS OF HONOR

rank as continental "counts," and their wives were called "countesses." Under the earls were the men who had smaller grants, but ranked above their knights. At first all the nobility were called "barons," which meant "men of quality." Later it became the specific title of the lesser nobility. To give princes and relatives of the king a higher rank than the earls, King Edward III in 1337 created the title of "duke," to rank above that of "earl," by making Edward, the Black Prince, the Duke of Cornwall. Today the highest rank of nobility next to the king and the royal princes, is that of duke, and even now there are few English dukes not of royal blood. There are exceptions, such as the Duke of Wellington, whose ancestor won his high rank by military victories.

Titles of Peers and Others

The frontiers or "marches" of the feudal kingdoms were often attacked by an enemy, and the head of such a district was called a "marquis" or "marquess." The first marquis in England was created in 1385, and was given a rank between that of duke and earl. Then between the earls and the barons were created "viscounts" (meaning vice-counts); the first was created in 1440. All these titles were given to the heads of districts and the holders of great estates. Under them were the knights and their squires (*see* Knighthood). The knights were not of the peerage (nobility), and their rank was not hereditary. In 1611 King James I created from the landed gentry an order of hereditary knights called "baronets." These hereditary knights rank between barons and knights and add after their names the abbreviation "bart."

The term "esquire," at first applied to the young man who bore the knight's shield and lance, has so far lost its original significance that nowadays it is given by courtesy to anyone called a gentleman.

In the United States, the word "mister" or "master" is used for everyone, but it was originally the title of a gentleman, a rank between the squires and the ordinary people. Mister (master), like *herr* in Germany, and *monsieur* (my lord) in France have come to be used indiscriminately as polite address.

Differences in English and Other Titles

While in England titles have a definite relationship to each other, this is not true everywhere. Many little states that grew up in Europe were absorbed in empires and separated again until there were many rulers of independent countries who could bestow titles. In France certain of the lesser titles could be taken by landed proprietors. Also, in Europe, the title was a family honor, not a personal honor. In England only the oldest son could inherit the title, according to the law of primogeniture; but in many European countries all sons of a count, for example, were also called counts.

In France all titles were abolished after the Revolution. Then Napoleon I created a great many new titles, and Louis XVIII, after his restoration, added many more; in addition all the old titles were revived, while those given by Napoleon were retained. The revolution of 1848 again forbade titles, but Napoleon III created new ones, and old ones were again revived. When France finally became a republic in 1870, titles were not even mentioned in the constitution, and today are held as a courtesy.

Titles for Sons of Noblemen

Courtesy titles are also found in England, where sons of the three highest ranks of nobility are always given a title below that of their father. Thus the eldest son of a marquis is usually referred to as an earl, and given one of the minor titles which is actually held by his father; legally, he is only a commoner. Younger sons of a marquis are called viscount. The present Duke of Wellington has among others two titles of marquis, two of earl, two of viscount, and two of baron, besides his Spanish, Portuguese, and Dutch titles. His eldest son, therefore, is called Marquis Duro, and his grandson is called the Earl of Mornington.

Strictly speaking, titles are not personal property. The lands (and the titles and duties that went with them) were first granted by a king at his pleasure, and could be taken back by him. So titles can be lost and revert to the king, when the line dies out, or because of some crime committed by the holder. Where democracies have succeeded kings, the legislatures often have abolished titles. The Constitution of the United States (Art. 1, Sec. 9) says that no title of nobility shall be granted by the United States, and persons in the government service are prohibited from accepting honors from foreign countries without the consent of Congress. Also, persons being naturalized are required to drop all titles they may hold.

How British Titles Rank

For men, the order of precedence among the British nobility runs thus: king, dukes of royal blood, other dukes, marquises, eldest sons of dukes (marquises by courtesy), earls, eldest sons of marquises (earls by courtesy), younger sons of dukes (earls by courtesy), viscounts, barons of the nobility, baronets, knights of various grades, esquires, and gentlemen ranking below the peerage. Within each group there is a careful ranking of individuals depending on the date the title was created, and whether it is English, British, Scottish, or Irish.

Precedence in a democracy such as the United States is based upon the official position of the individual. Thus, in official Washington there is fairly well-defined precedence—the president, vice-president, ambassadors, justices, ministers, speaker of the house, cabinet members, senators, etc.

In Great Britain the proper form of address in conversing with the nobility is somewhat confusing. Knights are always called Sir, but if Mr. Richard Johnson is made a knight, he is not called Sir Johnson, but instead Sir Richard, or Sir Richard Johnson. This is because when knights were first created, people did not have family names. Titles of nobility are distinct from the actual name of the holder, so if Sir Richard Johnson is made a baron he keeps his family

name, although he may take a new title, such as Baron of Aarondale. He is then addressed as Lord Aarondale. Dukes and duchesses are always addressed as such, but the other nobles, including those by courtesy only, are addressed as Lord or Lady. Younger sons of earls, and sons of viscounts and barons (these do not have courtesy titles) are addressed as Honorable (Hon.), but use the given name and the family name, not the title.

British forms of address to women are even more complicated, for while men hold titles for themselves, women may rank because their father held a title or because they married a man with a title or rank, or were themselves given a rank. A "lady" who has that title because of birth (the daughter of a duke, marquis, or earl), uses it with her given name, as Lady Alice; but if she acquires it by marriage, she uses it with her husband's name. Thus a knight or a baronet may be Sir Richard, while his wife is known as Lady Johnson. The rank of "dame" is the feminine equivalent of knighthood. It is applied not only to the wives and widows of knights and baronets, but is conferred as a title, as for example "Dame of the Order of the British Empire."

The heads of the Church of England, the Archbishop of Canterbury and the Archbishop of York, and a certain number of bishops, are members of the House of Lords and rank as members of the British peerage; ordinary bishops rank just above barons. Cardinals of the Roman Catholic church are called princes of the church, and many priests who are not bishops are granted the title "monsignor," which is equivalent to "my lord." The pope also may confer the title of "count" on lay persons. The Golden Rose, consecrated by the pope, and conferred on some distinguished individual, church, or community, is an honor of the highest rank (*see* Crusading Orders).

Orders of Knighthood

The rank of knighthood is frequently conferred by the British sovereign today, in recognition of special services in politics, literature, or science.

Among the important British orders are these: Order of the Garter, established by Edward III about 1348, and consisting chiefly of members of the royal family. Its motto is *Honi soit qui mal y pense* ("Evil be to him who evil thinks"); membership is indicated by the letters "K.G." after the name; the Order of the Thistle, an ancient Scottish order dating from 1687; initials "K.T."; Order of St. Patrick, for Ireland, created in 1788; initials, "K.P."; Order of the Bath, founded in 1399, three classes—Knights of the Grand Cross (G.C.B.), Knights Commanders (K.C.B.), and Companions (C.B.); Order of St. Michael and St. George, created in 1818 (G.C.M.G., K.C.M.G., and C.M.G.). Other British orders are the Order of the Star of India (G.C.S.I., etc.); Order of the Indian Empire (G.C.I.E., etc.); Victorian Order (G.C.V.O., etc.); and Order of the British Empire.

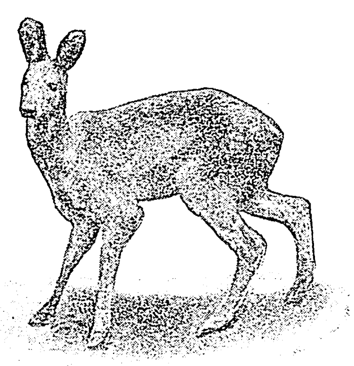
The chief orders of knighthood in other countries are the Order of the Golden Fleece (Spain and Austria); Order of the Annunziata (Italy); Order of the Black Eagle and Order of the Red Eagle (Prussia); and Order of the Chrysanthemum and Order of the Rising Sun (Japan).

The papal orders of knighthood for distinguished laymen are (in the order of their importance) the Supreme Order of Christ, Order of Pius IX, Order of St. Gregory the Great, Order of St. Sylvester, Order of the Golden Militia or Golden Spur, and Order of the Holy Sepulchre.

Many minor orders given by various European countries are merely honorable distinctions, and confer no title or precedence. Examples of these in England are the Order of Merit and the Companions of Honour.

Other honorary distinctions are conferred by universities and learned societies throughout the world. Universities give honorary degrees for outstanding work in almost any field of endeavor. Learned societies such as the French Academy, the Royal Society and the Royal Geographical Society (both British), and the American Academy of Arts and Letters recognize distinguished achievement by invitations to membership and by medals and prizes.

A "PERFUME BEARER" OF INDIA



The little Musk Deer—he's about 20 inches high—carries under the skin of his abdomen a gland which yields the valuable "musk" so much used in making perfumes.

DEER. Like cattle and antelopes, deer are hoofed and cud-chewing animals; but unlike cattle and antelopes, they have solid horns or "antlers," which are usually grown only by the males, and are shed and renewed once every year from the frontal bone of the head. It takes from ten weeks to four months for the antlers to attain full size. The renewal takes place during the spring and summer while the mother deer are rearing their young. The growing antlers are richly supplied with blood vessels and covered with a soft hairy skin called "the velvet." When the antlers are full-grown a ring is formed at their base which pinches off the blood vessels. The velvet then shrivels up and comes off in strips, or the animal may brush it off by rubbing against tree trunks or bushes. Female caribou and their relatives the reindeer carry antlers, but the females of other deer do not, except occasionally in a rudimentary form.

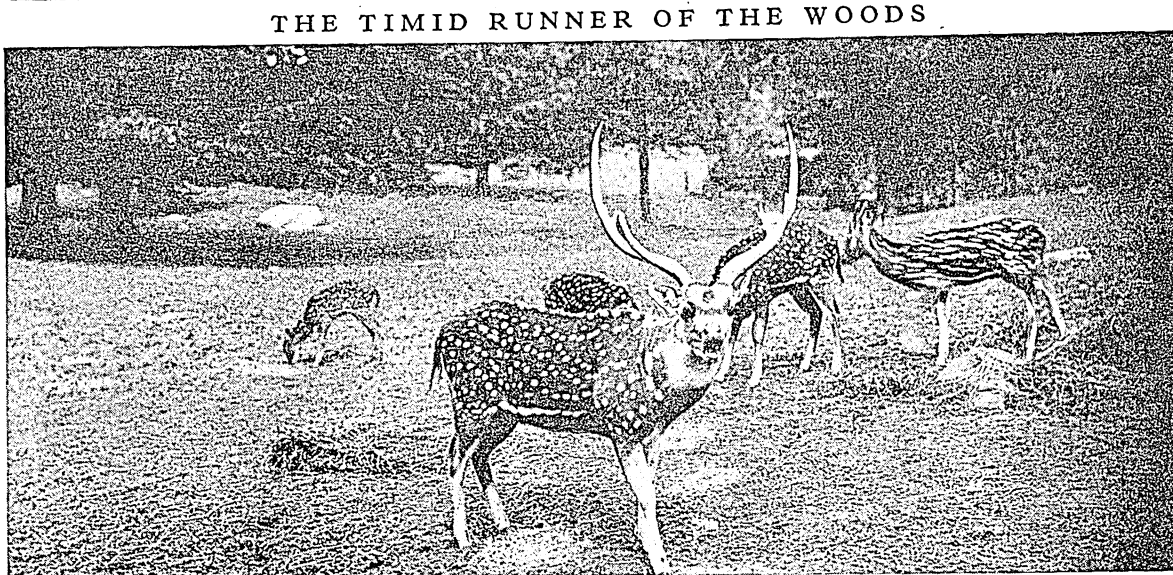
The coat is renewed twice a year, in spring and autumn, at least over the body and neck. The winter coat is heavier and its hairs are coarser and longer than those of the summer coat. All deer are easily tamed. In the wild state they are timid and peaceable except during the breeding season. They feed on leaves, twigs, grass, lichens, moss, and juicy plants, and as a rule drink at sunset.

How Young and Old Deer are Named

The young of the deer are spotted, and in the Virginia deer and their allies are called "fawns," while the young of moose and caribou are called "calves." The female deer is called a "hind" or "doe," while the female moose or caribou is called a "cow." Males are variously termed "stags," "bucks," or "bulls."

Writers differ greatly in regard to the number of species of deer but there are not less than 30, found

THE TIMID RUNNER OF THE WOODS

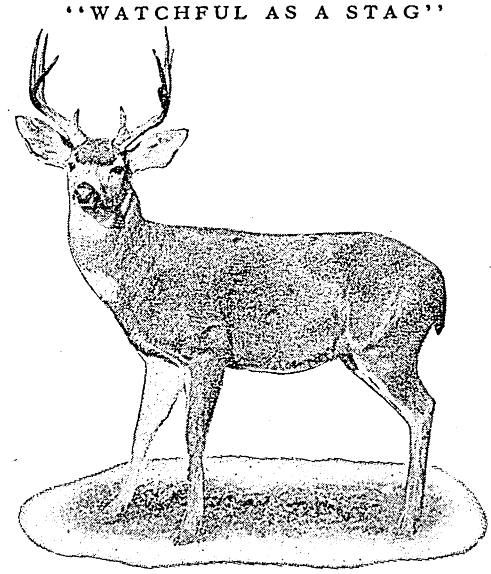


Deer are found in virtually all parts of the world except Australia, Southern Africa, and certain islands. Everywhere their beauty and grace are admired. The group above is a family of Axis Deer from India.

on all the continents and large islands, except Australia, New Zealand, Madagascar, and Southern Africa. The deer of the tropics and sub-tropics are usually inferior in size and beauty to those of temperate regions. One exception is the axis or spotted deer of India and Ceylon. Among the more important groups are the red deer, the reindeer (called caribou in America), the wapiti (miscalled "elk"), the true elk (known as the moose in America), the Virginia deer, Columbian black-tail deer, and the mule deer.

The red deer, found only in Europe, is the most abundant. It is commonly called the "stag" and often so named in song and story, although the term stag is also used to denote the male of any species of deer. The red deer is about four feet high at the shoulder and seven feet long. The antlers project upward and outward, and a full-grown buck presents a fine appearance during the autumn and winter months. Their senses of sight, smell, and hearing are very acute, and they are timid and fleet.

"WATCHFUL AS A STAG"



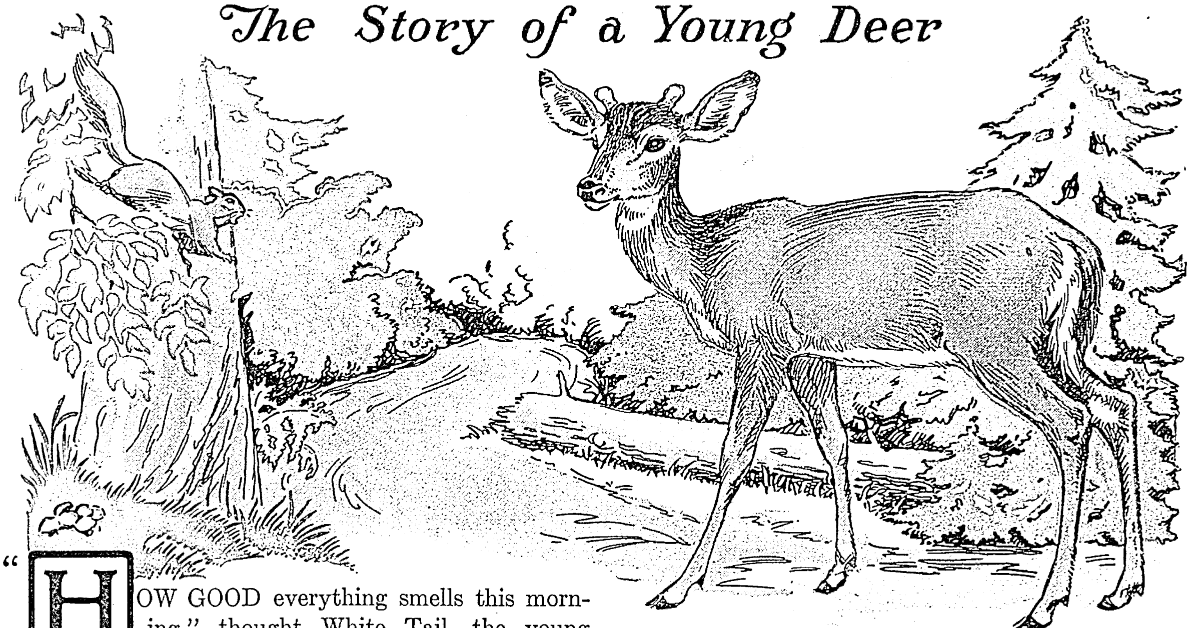
The male deer, called "stags," are the guardians of the family, whose duty it is to warn of approaching danger. This Mule Deer stag has perhaps heard the crack of a twig under the photographer's foot.

The Virginia or white-tailed deer has the widest range of any deer in any part of the world. It was formerly found everywhere in the United States except in Delaware, Oregon, Nevada, and California. In northern United States, where it attains a larger size than in the Great Plains region, it is known by a different specific name. The Virginia deer of Texas is also large. Diminutive races of this deer in Arizona and Florida are known as Arizona white-tailed deer, and Florida white-tailed deer, respectively. In Canada it is sometimes miscalled the "red deer." It is given the additional name "white-tailed," because of its bushy wedge-shaped tail, snowy-white underneath and on the edges. When the deer runs, the tail is held aloft like a waving white flag. Its antlers are cylindrical and rise a short distance from the forehead, then the beam grows forward abruptly and from it arise long sharp tines, generally three after the buck has reached maturity. Virginia deer are forest animals and protect themselves by staying persistently in the cover of brush or timber and carrying their heads low. They are graceful in body and beautiful in coloring, and in parts of their range attain a noble size, some individuals reaching a weight of more than 300 pounds.

The Columbian black-tailed deer of the Pacific coast of America is smaller than the Virginia deer. The outer surface of its tail is black and gives the creature its name. The antlers vary in shape, in some individuals forming a double Y shape, in others branching much as in the white-tailed deer, which it resembles in color. It inhabits the well-watered and

WHITE TAIL *and the* OLD STAG'S LESSON

The Story of a Young Deer



"What a fine fellow!" said the Squirrel

"HOW GOOD everything smells this morning," thought White Tail, the young deer, as he went along a forest pathway. It was a fine morning late in summer, and White Tail was on his way to a near-by stream to breakfast on the rushes and water weeds that grew there. His small pointed hoofs made scarcely a sound as he walked, and his long ears were pointed forward, alert and listening. Those ears caught every small sound and warned him of danger while it was yet a long way off.

Though the sun had just risen, many of the forest creatures were already abroad. They looked at him admiringly. He was a handsome young deer, with his slim legs and his rich brown summer coat that glistened almost red where the sun reached it.

"Good morning, White Tail," a squirrel called out from a tree. "What a fine fellow you are growing to be!"

"Thank you, Squirrel," White Tail answered. "I have grown a good bit, haven't I?"

"Indeed you have," said the squirrel. "Why, last year you were only a little fawn. You couldn't go anywhere without your mother."

"Yes," White Tail answered quickly, "I used to be afraid to leave her. But now I go about alone whenever I like."

"Well, don't let it make you too proud, or you will get into trouble," said the squirrel, as it whisked down the tree and scampered away.

White Tail was greatly pleased that the squirrel had noticed how much he had grown, and he held his small head high as he went along.

Presently, as he stopped to nibble at a bush beside the path, a pair of branching antlers was suddenly lifted, and there stood an old stag looking right into his eyes.

"Excuse me," the young deer said politely. "I didn't know you were feeding here. I am White Tail, and I only wanted to eat a few leaves from this bush. I didn't mean to startle you."

"You didn't startle me," the old stag said. "I knew you were coming. I heard a squirrel chattering with you; and once I heard you paw the ground when you stopped to browse."

White Tail was ashamed at the old stag's words, for he knew that one of the first things a young deer should learn was to pass through the forest without making any noise. "I will be more careful next time," he thought. Then, looking curiously at the old stag, he asked, "Aren't you a stranger here? I don't remember seeing you before."

"Yes, I am a stranger," the old stag told him, "and I have come from a great distance. I wonder if you could tell me where I can find some salt," he went on. "I do not know the country around here, and I am hungry for salt."

"Yes, sir," White Tail answered. "I know where there is plenty of salt. If you will come along with me, I will show you."

The two deer set off together through the forest. At first, White Tail felt a little shy, but presently he

ventured to say, "What a fine pair of antlers you have, Old Stag! I never saw such huge ones before."

"There are plenty of antlers as large as mine," the old stag told him. "Some are even larger. But my antlers have served me well in many a fight."

White Tail felt a new respect for this old stag who had come from such a distance, and who spoke so quietly about the fights he had had. "I wish my antlers were large," he said. "It must be fine to have big antlers to fight with."

"A fine pair of antlers!"

The old stag looked at the two small spikes growing out of White Tail's head, and he was a little amused at the young buck who was in such a hurry to grow up. "You will have plenty of fights when you are older," he said, "but there are many things that you must learn before your antlers are ready to fight with."

"What things?" White Tail asked.

"Well," said the old stag, "I noticed a moment ago that you stepped on a dead twig and snorted when it snapped under your feet.

"It is," the old stag answered. "But there are times when I have no antlers. Did you know that, White Tail?"

"No," said White Tail, in amazement. "What happens to them?"

"Each year, in winter, they fall off," the old stag replied. "And then for a while I have no antlers at all."

"Will mine do that, too?" asked White Tail.

"Yes, your antlers will fall off in the winter, and new ones will grow again in the spring. For a long time after the antlers begin to grow, they are tender and easily hurt. So they have a soft, velvety covering to protect them. But when the time comes, we rub the covering off against a tree or bush, and then our antlers are fine and hard again, and we are ready to fight with them."

"I hope my antlers will soon be hard," White Tail said, "and then I will fight with them."

You must learn to be quiet in the forest. You must not snort. You must not make any noise at all. For if you do, some day the Hunter will find you, and then you will be sorry!"

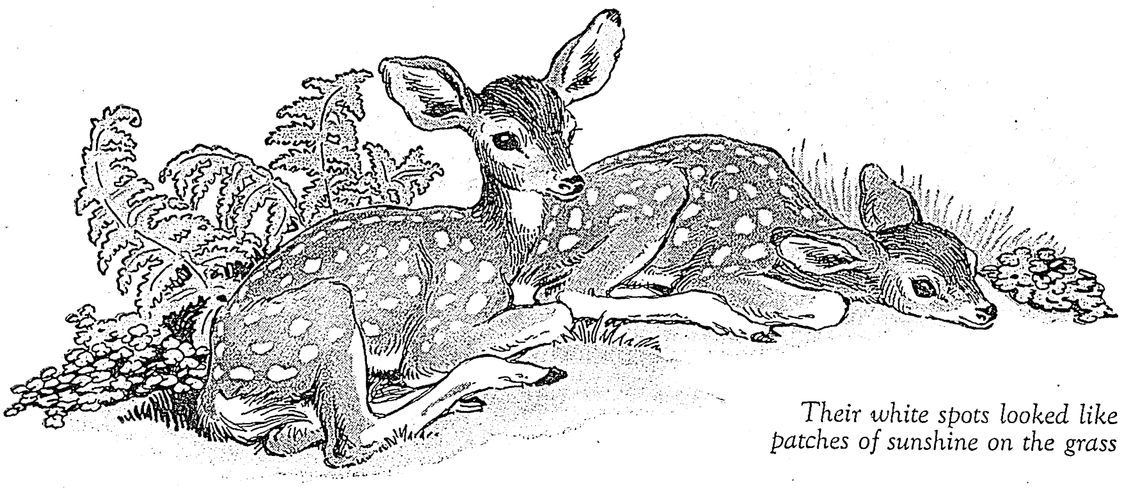
White Tail stopped in his tracks. "What is the Hunter?" he asked. "I do not know him."

"The Hunter is a danger," the old stag said. "He comes into the forest to look for us, and if he sees us, he tries to kill us."

"Tell me more about him," White Tail said anxiously. "Won't you?"

"No," replied the old stag, "I want to hurry along to that salt lick. You ask your mother. She will tell you all you need to know."

Now they had reached the edge of a shallow ravine. White Tail turned from the path they had been following and led the way through dense underbrush out into a wide, well-beaten runway. "This is the road to the salt lick," he said. "We'll soon be there now."



Their white spots looked like patches of sunshine on the grass

The old stag had seen such paths before. "It has taken a long time to make a runway like this," he said. "The feet of many deer have passed this way."

Soon they were in a rocky glade, where a number of other deer were eagerly licking the soft, salty earth at the edge of a little stream. White Tail and the old stag at once began to lick up the salt that tasted so good.

After a little while the young deer raised his head and looked about him. The old stag had not yet had his fill of salt; so White Tail went over to some scrubby bushes and peeped through them. At first he saw nothing to interest him, but a moment later he caught sight of two small fawns on the ground not far away. Pushing his way through the bushes, he spoke to them.

"Hello, little fawns! I didn't see you at first, because the white spots on your bodies fooled me. They look like patches of sunshine on the grass."

"Our mother says that is why we have these white spots," one of the little fawns answered shyly. "They help to hide us from sight."

"I know," White Tail said. "I had them too, when I was as small as you. But mine have gone now, and yours will go before winter comes. You will have another coat for winter. It will be thick and warm, and it will not be spotted."

"I don't want another coat," said one of the little fawns, "I like my coat just as it is."

"Well," White Tail replied, "you will have a dull brown coat for winter, whether you want it or not. All deer change their coats before winter gets here. You have never seen a winter, and you don't know what it is like. It is a cold time, and the deer live together in the forest. Last winter the snow was piled so deep on the ground that we could not walk through it at all, and we had to keep paths open everywhere. I was hungry most of the time, for there was nothing to eat except a few small berries and the young branches of trees, and now and then a little dry grass and moss that we pawed up from under the snow."

He ran, his small head held high

"That seems very strange," said the fawns. "We have always had all we wanted to eat. We don't understand such things at all. But we must not talk any more now. Mother told us to keep very quiet until she came back to us."

"Where is your mother?" White Tail asked.

"She is over at the salt lick, but she will be back soon. She never leaves us very long."

"Don't you wish you were big enough to go about alone, the way I do?" White Tail asked. "Watch me now! See how fast I can run!"

He gave a leap into the air and ran a little distance, his small head held high, his short white tail erect. Then he turned and ran back; and this time, he did not stop beside the little fawns, but ran on into the rocky glade.

"Aren't you forgetting what I told you about keeping still?" the old stag scolded him. "You run about, making as much noise as though there were no such thing as a Hunter in all the world."

"I forgot," White Tail said. "I only wanted to show the fawns how fast I could run."

"You mustn't be too proud, or you will get into trouble," said the old stag, just as the squirrel had said earlier in the morning.

"I'm sorry," White Tail answered. "I'll try to remember next time."

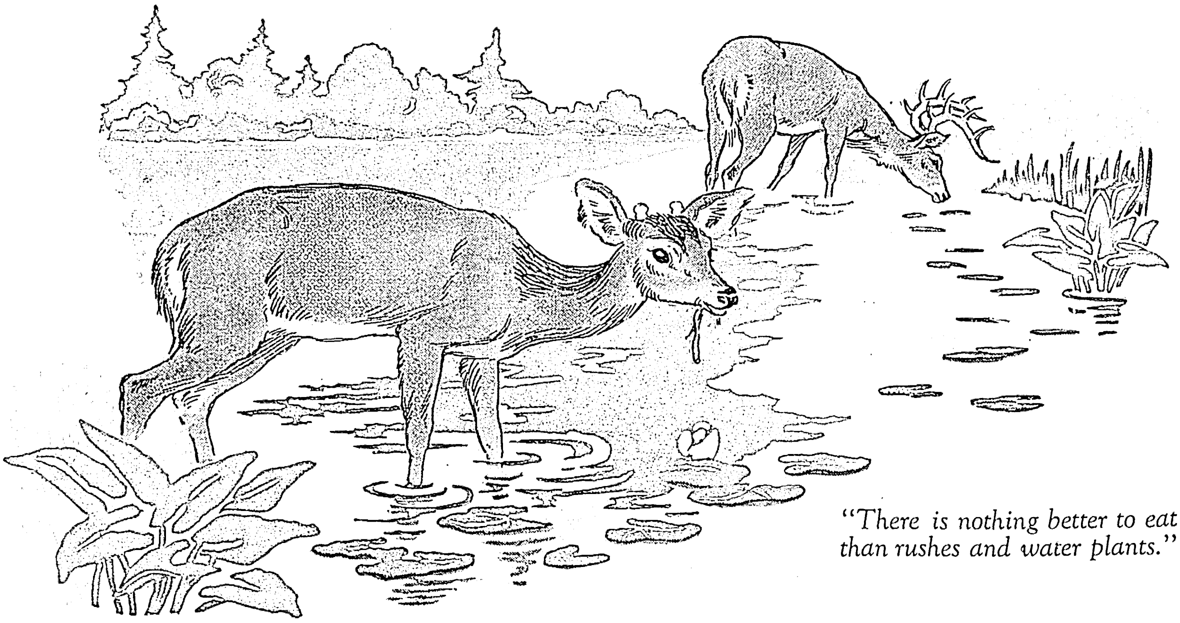
"All right," said the old stag. "And now suppose we look for something green to eat."

"I would like that," White Tail told him. "I know a stream where water lilies and rushes grow. Shall we go there now, Old Stag?"

"Yes," the old stag replied, "that will be fine. There is nothing better to eat than rushes and water plants. Besides," he added, "the flies are beginning to bother me, and I will be glad to splash about in the water for a while."

When they reached the stream, the two deer swam at once to the other side, where the rushes grew thickest.

White Tail liked to swim almost as well as he liked to run. After they had eaten all they wanted of the fresh green leaves and the tender stems, he swam about in the cool water, while the old stag rested on



"There is nothing better to eat than rushes and water plants."

the shore and chewed his cud. The young deer would have liked to stay there all day. He was sorry when, by and by, it was time for them to return. "The sun is getting high," the old stag said, "and we are not safe out here. Night is the best time to come to the stream to eat."

Crossing to the other side, they made their way back along the forest path. They had not gone far when the old stag suddenly stopped and listened. "Keep very still, White Tail!" he whispered. "I hear the Hunter!"

In spite of the old stag's warning, White Tail took a few quick steps forward, as though he were about to run. "Keep still!" the old stag repeated sharply. "He may see you if you move. The wind is blowing toward us, so I can smell him plainly. I can tell just where he is each moment. I will warn you if there is any need to run."

White Tail sniffed the air anxiously, and there came to his nostrils a strange new smell, a smell that he would never forget for the rest of his life.

In a moment the old stag whispered again. "Do you hear the cawing of the crows and the screaming of the jays? It is their warning to the forest creatures. They have seen the Hunter. Keep your head low behind the bushes, White Tail."

The young deer did as he was told. It seemed a long time that he stood there, trembling, not daring to move. "You can see him now, White Tail, if you peep through the bushes," the old stag said at last.

White Tail had never seen a man before. At the first sight of the Hunter, coming down the hillside, he was so frightened that, in spite of all the old stag had said, he turned and ran as fast as he could. He did not stop until he reached the middle of the forest.

For a long time he stood there, tired and panting. But though he strained his ears, he heard nothing, and he knew that for this time he was safe.

"I should not have run so soon," he said to himself. "The Hunter might have seen me."

Presently White Tail saw the old stag coming along the forest pathway. "I am sorry I ran, Old Stag," he said. "Are you very angry with me?"

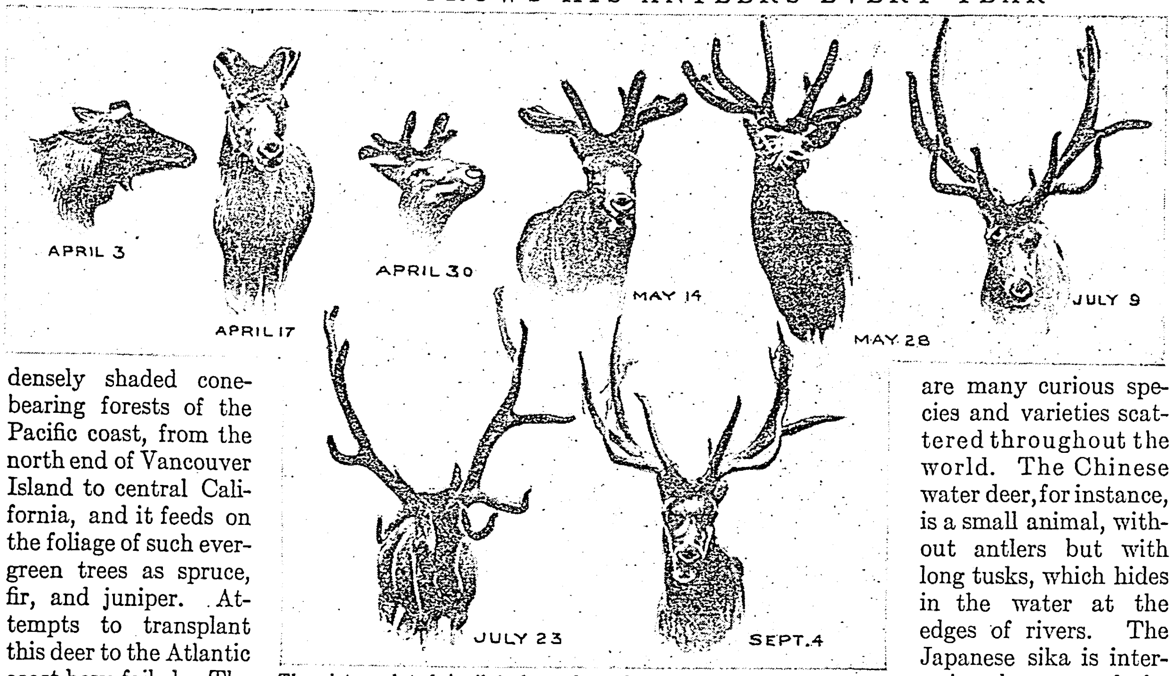
"No, I would have done the same thing, at your age, I suppose. And I have seen older deer than you run from the Hunter. But the next time you see him, you must keep as quiet as you can, until you are sure which way he is going. Do not let him see you if you can help it, White Tail, for the Hunter is the greatest enemy we have. Always remember that."

"I will," White Tail promised. "Next time I won't forget a thing you have told me."

"I will not be with you the next time you see the Hunter," the old stag told him, "for I must be going on now. But you are a fine young buck and will soon know how to take care of yourself. I hope I will see you again some day."

Without another word, the old stag went off into the forest, his head held high and his long ears pointed forward, listening for danger. White Tail stood watching him until at last he disappeared from sight. Then he turned and went back the way he had come, thinking of the exciting story he had to tell his mother and the many questions he wanted to ask her.

HOW THE STAG GROWS HIS ANTLERS EVERY YEAR

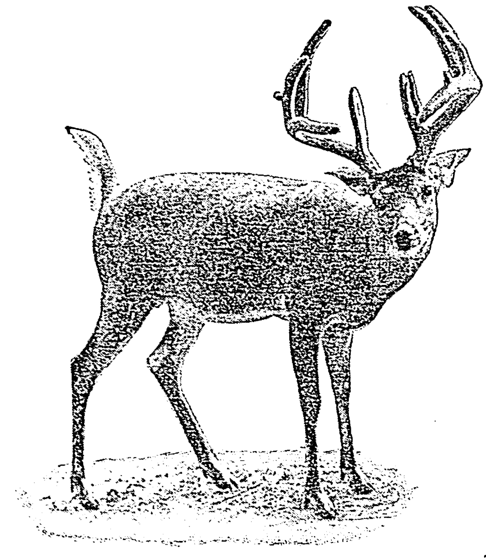


The picture dated April 3 shows how the stag appears in the spring, after he has lost his last year's pair of antlers. The pictures up to May 28 show the antlers in "velvet"—that is, incased in the fleshy substance which covers them until grown. The remaining pictures show the completion of growth and loss of the "velvet"—and then Mr. Deer is all dressed up with fighting antlers for a few months, until it is time to grow a new pair.

densely shaded cone-bearing forests of the Pacific coast, from the north end of Vancouver Island to central California, and it feeds on the foliage of such evergreen trees as spruce, fir, and juniper. Attempts to transplant this deer to the Atlantic coast have failed. The Sitka deer is a smaller variety of the Columbian black-tailed deer.

The mule deer is a handsome animal, larger than the Virginia deer. It is easily recognized by its very large ears, the peculiar double branching of its large antlers, its short white tail tipped with black, and the white patch on the rump. In winter its color is steel gray, in summer grayish brown. Its home is among the picturesque "badlands" and foothills of the Rocky Mountain region and the deep ravines along rivers, but it also inhabits high plateaus. It is a spirited high-headed animal, and a bold traveler. It is found most abundantly from Colorado to southern British Columbia, but survivors are also seen in parts of Mexico, and as far east as North Dakota. It has been killed faster than it could breed, so that its extermination is probable unless it receives protection. It is difficult to acclimatize this deer in the region east of the Mississippi owing to the absence there of the rarefied climate and dry food which seem essential to its well-being.

WHO GOES THERE? FRIEND OR FOE!



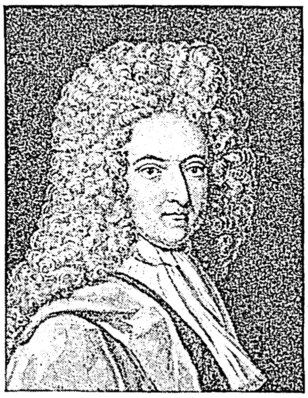
This White-Tailed Virginia Deer is hovering between fear and curiosity. In another second he'll be bounding away to safety.

In addition to these more common groups of deer, there are many curious species and varieties scattered throughout the world. The Chinese water deer, for instance, is a small animal, without antlers but with long tusks, which hides in the water at the edges of rivers. The Japanese sika is interesting because of the patch of white hair on the rump. When the animal is quiet, these hairs lie closely bunched; but when it is alarmed, they flare out into a chrysanthemum-like bunch, which serves as a guiding mark for the herd while in flight. Several varieties of this deer are distributed over Manchuria.

The muntjac of India is almost piglike in bodily structure, with short legs and neck. These deer are awkward runners and can barely outdistance a sheep; but they show remarkable facility in crawling about through underbrush. Indian sportsmen often call them "barking deer," because their cry of alarm is a bark like that of a fox. The smallest deer is the "pudu" of the Chilean Andes; it is only 18 inches high. South America also has the numerous family of the "brockets"—deer the size of roe-bucks and smaller, with simple spike-like antlers. The "pampas deer" is abundant in Argentina, while in the Chilean and Peruvian Andes we find the "guemals."

The wapiti, moose, caribou, and reindeer are described in separate articles under those headings.

DEFOE′, DANIEL (1660?–1731). Just as Jonathan Swift is known first of all by 'Gulliver's Travels', so Daniel Defoe, "first of journalists and prince of story-tellers," is known by his best book, 'Robinson Crusoe'. People who hardly know the name of its author can give you full accounts of Crusoe's island, of the shipwreck, the raft, and of "my man Friday."



DANIEL DEFOE
Author of the famous story 'Robinson Crusoe'.

Defoe was born in the parish of St. Giles, Cripplegate, London, probably in 1660. His father was a butcher. The family were Dissenters; that is, they belonged to a religious group which did not believe in, or had "dissented" from, the established Church of England. Young Defoe was brought up in the strict and pious training of the family's beliefs. At school he studied modern languages and geography, as well as the traditional subjects of Latin, Greek, and history. Though destined for the ministry, he went into business about 1685 as a middleman dealing in hosiery and allied merchandise, and he was at one time a commission merchant. In 1692 he failed for about $85,000. By 1696 he had gone into the business of making bricks and tiles.

About this time he began writing various political and ecclesiastical pamphlets. In 1698 he wrote an 'Essay upon Projects', a sociological study in which he made suggestions for a national bank, friendly societies, asylums, reformed bankruptcy laws, and plans for academies of learning. He also wrote in favor of a standing army.

His love of satire found expression in his pamphlet, 'The Shortest Way with the Dissenters' (1702). Written anonymously, it pretended agreement with the high Tory policy of persecuting the Dissenters but recommended fantastic penalties. Accepted seriously at first, it pleased the high Tories and enraged the Whigs. But when it was discovered to be a satire, the government ordered his arrest, describing him as "a middle-sized, spare man, about 40 years old, of a brown complexion and dark brown colored hair, but wears a wig; a hooked nose, a sharp chin, gray eyes, and a large mole near his mouth." He received the severe sentence of three days in the pillory and an indefinite term in prison. At this time he wrote his celebrated 'Hymn to the Pillory' and won many sympathetic friends. During his imprisonment his tile business went to ruin, with debts mounting to about $15,000.

He was released from prison in 1703 through the influence of Robert Harley, at that time speaker of the House of Commons and later secretary of state. Harley sensed the power of the press and knew the value of a tractable pen. Defoe helped repay him by writing numerous reports and pamphlets for him, and by working as an election agent, and later as a secret agent in Scotland.

In 1704 Defoe brought out his *Review*, a brilliant commentary on questions of the day. Its timely notes appeared without fail until 1713. It was the first of many such periodicals with which Defoe was connected, and which were the forerunners of the modern newspaper. Fiction as such was not acceptable to the people of his day, so Defoe wrote various "true histories" about pirates, thieves, and adventurers. When facts were missing, he drew on his imagination, making up the characters and the events. In 1719 he produced 'Robinson Crusoe', based upon the adventures of Alexander Selkirk. Told in Defoe's usual style, easily read by all, the tale won instant and universal acclaim. (*See* Crusoe, Robinson.)

Defoe's chief works were: A satirical poem, 'The True-born Englishman' (1701); 'The Shortest Way with the Dissenters' (1702); 'Robinson Crusoe' (1719); 'Captain Singleton' (1720); 'Moll Flanders' (1722); 'A Journal of the Plague Year' (1722); 'A Tour through the Whole Island of Great Britain' (3 vols., 1724–1727).

DEHY′DRATED FOODS. Drying food to preserve it is an ancient custom. Dried olives, raisins, dates, and figs have been common in Mediterranean lands since the days of ancient Greece. Dried fish was a staple in Scandinavian countries before the Christian Era. Indians provided winter food by cutting buffalo meat into strips and curing it in the sun. Without the dried prunes, apricots, and apples shipped from the East, the early white settlers in the Great Plains would rarely have tasted fruit.

Drying preserves food, because the molds and bacteria of fermentation or decay cannot thrive without moisture. But ordinary ways of drying leave so much moisture that the food may still spoil. In recent years scientific methods for forced drying have been developed, and so-called *dehydrated foods* are the result. They are widely used by explorers and by armies, not only because they keep almost indefinitely but because their bulk and weight are greatly reduced.

Water may be removed from foods by certain moisture-absorbing chemicals. Or it may be drawn out by vacuum methods. But artificial heat is the usual drying agent. To prevent the heated foods from oxidizing, they must usually be shielded from the air. The steam rising from the food itself may be enough to do this. But in other cases the heating is carried on in a vacuum or in chambers filled with inert gases, such as carbon dioxide. Before they are dehydrated, vegetables must be blanched; fruits may be dried raw.

Tomatoes and other foods that do not have to retain their shape are usually dehydrated in the *drum* drier. The food is reduced to a paste and is spread on a steam-heated drum. One revolution of the drum, taking from 10 to 20 seconds, completes the drying. The food comes off in thin crisp sheets which are broken up into flakes or crushed into powder.

The *spray* drier is used especially for making powdered milk. Concentrated milk and hot dry air are blown into a chamber through concentric pipes. The milk dries almost instantly and settles to the floor where a conveyor takes it to an outlet.

Foods that are to be dried whole or in large pieces are usually dehydrated in the *tunnel* drier. This is a long heated passage through which trays of food move on trucks. The process takes about 12 hours. Vegetables dried in this way are usually cut up into chips or shreds. Whole apricots and other fruits may be dried in the tunnel, but they are not completely dehydrated. The *cabinet*, or *shelf*, drier is used when only small batches of food are to be dried.

Beef is dehydrated by a special process. It is first cubed and cooked at relatively low temperatures. Then it is ground and dried slowly. The dried product can be eaten just as it comes from the container. The addition of water gives it the consistency of ground fresh beef, and this can be served as hamburger or any other dish for which ground meat is used.

Food Value and How to Serve

Dehydrated foods retain most of the food values of the original product. Proteins and minerals usually do not evaporate, and calorie content remains about the same. Vitamins, in varying quantities, are lost, but to no greater extent than when foods are canned or quick frozen. Soups and sauces retain their taste better than most other foods.

Whole or large pieces of dehydrated vegetables must be soaked a long time before cooking. Powders and flakes mix easily with water and are ready to serve after a few minutes' heating. Milk, soups, and sauces are perhaps the most familiar dehydrated foods. Powders make good mashed potatoes. Dried eggs retain the properties of fresh eggs when used in cooking.

DE KALB, JOHANN (1721–1780). Adventurous young Johann Kalb left his peasant home in Bavarian Hüttendorf, changed his name to the French Jean de Kalb, assumed the title of baron, and joined the French army. Later he fought for the colonies in the American Revolution, losing his life after three years of distinguished leadership.

De Kalb had entered the French army in 1743 and had risen rapidly to the rank of brigadier general. In 1768 he was sent to America by the French government to investigate the possibilities of a revolt of the American colonies against England. The colonies were not ready for action at that time. When they did finally rebel, De Kalb offered his services and with Lafayette joined the American army under Washington in 1777 with the rank of major general. In 1780 he was sent south with some 2,000 men, and at the battle of Camden, S. C., on August 16, he was second in command to General Gates. When Gates fled from the field, De Kalb and his men sustained the attack of the whole British force until he fell, pierced with eleven wounds. Three days later he died, a prisoner in the hands of the British. A monument to his memory was erected in Camden in 1825, his old companion in arms, Lafayette, laying the cornerstone.

DELAWARE—*The "Blue Hen"* STATE

Extent.—North to south, 110 miles; east to west, 35 miles. Area, 2,057 square miles. Population (1940 census), 266,505.
Natural Features.—Hilly in north; largely flat, sandy country; marshy along Delaware Bay; abundant waterways. Mean annual temperature, 54° F.; mean annual precipitation, 45″.
Products.—Corn, wheat, hay, oats, soy beans, fruits, and vegetables; canned and dried fruits and vegetables; chemicals, fertilizers, paper, ships, yachts, railway equipment, airplanes, braided rubber, leather, vulcanized fiber, rayon, dental supplies, and pharmaceuticals.
Cities.—Wilmington (112,504), Dover (capital, 5,517); Newark, New Castle, Milford, Laurel, Bellefonte, Seaford, Lewes.

DELAWARE. An automobile can travel the length of beautiful little Delaware in an afternoon, but in that short time it will cross many a stretch of historic ground. Not only was Delaware one of the 13 original colonies, it was also the "first state" of the Union; for in 1787 it was the first to ratify the Federal Constitution. In the early days it was a gateway of exploration and settlement, and a leader in commerce and industry. Much of this colorful past lingers today, living side by side with modern industry and agriculture.

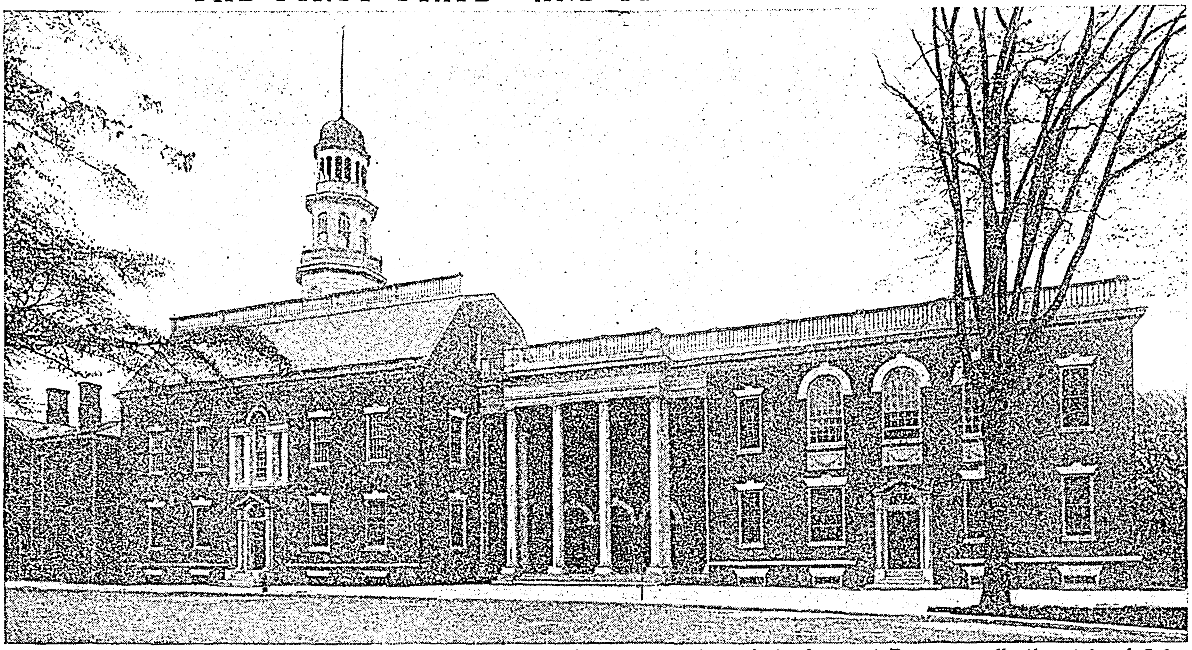
Northernmost of the South Atlantic states, Delaware is wedged in between New Jersey, Pennsylvania, and Maryland. It occupies the northeastern part of the fertile "Del-Mar-Va" peninsula between Delaware Bay and Chesapeake Bay. With its 2,057 square miles, Delaware is the second smallest state, only 843 square miles larger than Rhode Island. Its greatest length is only 110 miles from north to south. The greatest width is a scant 35 miles; the narrowest about 10 miles. With 266,505 people, it ranks 46th in population, but 10th in density, with an average of 134.7 persons to the square mile. The state has only three counties—New Castle, Kent, and Sussex.

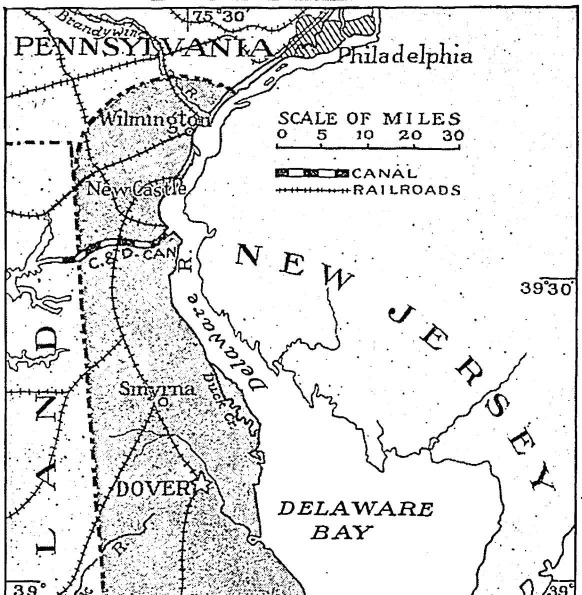
At the northern tip of the state is Wilmington, where almost half the people of Delaware live. This busy, modern city has shipyards, foundries, mills, factories, and a marine terminal for ocean vessels (*see* Wilmington). The rest of Delaware is almost entirely agricultural—a gentle land of farms, truck gardens, and orchards. As you drive the length of the state, on the superb Du Pont highway, you pass through drowsy market centers. They are serene little towns, beautiful with aged shade trees, village greens, and weathered homes built in early American simplicity. From the Du Pont highway, other excellent roads lead east and west to tidewater farming centers and fishing hamlets. Today they seem to slumber. But in the early days of our nation they were thriving ports, crowded with commerce and shiploads of eager immigrants to the New World.

Natural Advantages Bring Early Settlement

The first white man to see the shores of Delaware was Henry Hudson. On Aug. 28, 1609, as he sailed the *Half Moon* along the Atlantic coast in search of a northwest passage to the East Indies, he turned in here but soon saw it was a fresh-water outlet. A year later, on August 27, Capt. Samuel Argall sighted

"THE FIRST STATE" AND ITS HISTORIC CAPITOL





Delaware's capitol, above, at Dover, recalls the style of Colonial days. It was built during the years 1787–92, on the site of a Kent County courthouse erected in 1722. The map shows how most of the state's eastern border faces the sheltered waters of Delaware Bay and the broad mouth of the Delaware River—an attraction to early seafaring settlers.

the bay from his pinnace *Discovery*. He named the southern point of land (now Cape Henlopen) Cape La Warr, in honor of Lord de la Warr, governor of Virginia. From this came the name "Delaware."

The adventurous Dutch captains who explored the bay region from 1614 to 1620 saw a forested land spreading back from rolling dunes on the seacoast and from tidal marshes on the bay. Many inlets in the shore line and a network of navigable rivers and tidal creeks offered shelter for ships and easy water transport for inland settlements. Rich forests promised lumber for houses and fuel for warmth. The wealth of deer, fish, and game birds assured food in plenty. Profitable trade awaited, for Indians came down the Delaware River laden with furs for barter.

As part of the North Atlantic coastal plain, Delaware is virtually level. Small, steep hills and deep ravines break the land in only a small corner of the northwest where it juts into the Pennsylvania foothills of the Piedmont Plateau. There at Centreville, Delaware reaches its highest point—440 feet. Elsewhere it rarely rises more than 60 feet above sea level. Geologically young, the soil ranges from a light alluvial sand to heavy clay. For the most part it is sandy loam. Level and virtually free from stones, it is easily worked.

When Capt. Cornelis Hendricksen, first explorer of the Delaware River in 1614, returned to Holland in his ship *Onrust* ("Restless"), he took care to report on the climate. His record in 1616 declared, "He hath found the climate of the said Country to be very

temperate." No rigorous New England winters awaited Dutch colonists about to be sent to Delaware.

Its position between two arms of the ocean gives Delaware a tempered climate, gentler than that of its northern neighbors, yet brisker than in adjacent Maryland and Virginia. Its long growing season, from the latter part of April to mid-October, especially favors fruit production. In the north the mean annual temperature is 52° F.; in the south it is three to four degrees higher. During July and August, high humidity typical of the Middle Atlantic coast makes the heat "sticky." But in the long spring and autumn, Delaware is delightfully mild.

The average annual rainfall is about 45 inches, more than enough for the needs of the farmer and the fruit grower. Excess moisture cannot run off rapidly from the flat surface of the land and in many places swamps have formed. The largest is Pocomoke swamp, stretching into Maryland. The swamps and tidal marshes and the many ponds, lakes, and slow-moving streams are breeding grounds for mosquitoes. For many years these pests interfered with the development of vacation resorts. But drainage canals and other mosquito-abatement measures have brought the pests well under control.

Rich Variety of Plants and Animals

About one-sixth of the state is still in timber, much of it in farm wood lots—chiefly pine, oak, hickory, walnut, beech, maple, ash, sycamore, tulip (yellow poplar), and sweet gum. Other trees and shrubs, chiefly in the south, include loblolly pine, persimmon, magnolia, laurel, wild cherry, holly, white dogwood. Bald cypress and white cedar grow in the swamps, and along the sandy ocean shore grow pitch pine, willow, blackjack oak, red cedar, beach plum, and wax myrtle.

Timber was the source of some of Delaware's earliest industries. Great stands of white oak helped Delaware to become a leader in shipbuilding. Merchant vessels called "Delaware racers" were built by Dutch and Swedish colonists, and were famed up and down the seaboard for their speed. Many cargoes of white oak timber were exported to England, Holland, and Sweden. The bark of the black oak supplied tannin for the tanning and dyeing industry which was widespread in Delaware even before the 18th century. Other woods furnished boxes, baskets, and barrels for tons of flour and corn meal exported when Wilmington was a milling center of the colonies.

After generations of ruthless logging, timber is now protected by state conservation. The state forestry department, established in 1927, has jurisdiction over all woodland. It reforests private land at cost. To encourage planting windbreaks and shelterbelts, reforested lands are supervised by the department and are exempt from taxes for 30 years. The chief public forest is Redden State Forest in Sussex County.

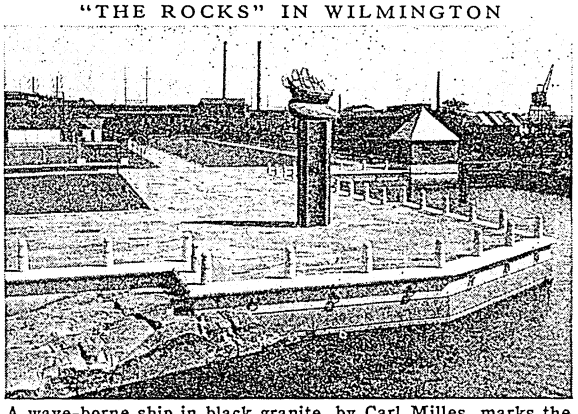
Wild Life and Fishing Industry

Delaware is still a haven for wild life. The bear, panther, wild cat, and wolf of early days are gone. But there remain muskrat, opossum, red and gray fox, rabbit, squirrel, raccoon, and mink. Muskrat trapping in southern marshes is the livelihood of a number of people. Some deer are still found. Diamond-back terrapin are now scarce, but were once so numerous and cheap that a law was passed to forbid employers to serve it to their workmen more than three times a week.

The state lies on the eastern flyway of the annual migration of birds (*see* Migration of Animals). Because of its moderate climate, some of them nest here beyond their usual northern limits. In addition to birds found generally on the Middle Atlantic coast, Delaware has bald eagles, snowy egrets, blue heron, yellow-throated warbler, and summer tanager. Ducks, quail, and pheasant are hunted. The copperhead is the only poisonous snake.

Wild life is kept well stocked by the state board of fish and game commissioners, established in 1911. In 1935 a law empowered the board to spend a fourth of its income on game birds, fish, and animals for restocking. Some farmland unfit for crops is set aside for game preserves, and the farmers are paid to plant feeding patches and to guard the wild life. In 1937 the United States Biological Survey bought 12,000 acres of marsh and upland on Delaware Bay near Dover, establishing Bombay Hook Migratory Wild Fowl Preserve, chiefly for wild ducks and geese.

"THE ROCKS" IN WILMINGTON



A wave-borne ship in black granite, by Carl Milles, marks the rock where the first Swedes landed in 1638. Prince Bertil of Sweden presented it to President Roosevelt in 1938.

Few states offer more opportunity for fishing, in both fresh and salt water. The lakes are fished for crappies, bream, and large-mouth bass. Power boats sail the bay and coastal waters for flounder, channel bass, kingfish, croakers, and sea trout or weakfish, caught with pole and line. Commercial fishermen also net shad, herring, rock, and sturgeon. Clams are dug, and hard- and soft-shelled crabs are also taken. Fleets of boats still dredge for oysters, and some lobsters are caught at the mouth of the bay.

In 1936 Delaware joined with Pennsylvania, New York, and New Jersey to form the Interstate Commission on the Delaware Basin. This aimed to conserve

and develop the resources of the Delaware River. Sewage and industrial wastes were major problems, for pollution of the waters had virtually wiped out sturgeon and had taken huge toll of the valuable Delaware shad.

Abundant Waterways Gave Early Advantage

No single factor contributed more to the early development of Delaware than its abundant waterways. Its Atlantic coast line is cut by many inlets and bays, chiefly Rehoboth, Indian River, and Assawoman bays. In the days of the small sailing ships these inlets were gateways of commerce. So were the streams leading into the interior.

The watershed of the state is a small ridge on the west boundary, which turns southeast below the center of the state. Flowing east into the Delaware River and Delaware Bay are the Appoquinimink, Smyrna (formerly Duck creek), Mispillion, and the oddly named St. Jones. On the west slope is Chesapeake Bay's largest tributary, the Nanticoke. In the north, the Christina and historic Brandywine, flowing down from Pennsylvania, join to form Wilmington's deep water harbor.

As long as water transport ruled, Delaware was the cross-roads of the seaboard. Coastal settlements and those at the head of river navigation built ships and became leaders in coastwise and foreign trade. Tidewater plantations shipped from their own landings. As early as 1654 the Swedish governor, Johan Classon Rising, recognized Delaware's key position and proposed a canal across the neck of the peninsula. In 1797 plans were begun that resulted in opening the Chesapeake and Delaware Canal, 14 miles long, in 1829, one of the earliest in the nation.

Industries and the People Who Built Them

The fall of the rivers is slight, but it was enough to help make Delaware a leader in early industry. Rivers turned mills for grist, lumber, paper, textiles, and explosives. Wagon trains from Pennsylvania and Maryland brought grain to mills on the Christina and Brandywine. The Wilmington market set the price of wheat for the colonies. Delaware millers' invention of kiln-dried corn gave them hold on the West Indies trade with cargoes of meal free from mold. On the Brandywine the first Du Pont mill made its first powder run in 1804, the start of one of the largest industries in the nation. Iron ore in the north and bog iron in Sussex supplied many forges and foundries until late in the 18th century. Even before the Revolution, Wilmington was famed for wagon building. When railroads came, it turned to car building as early as 1836. The first propeller-driven iron ocean ship in America was launched here in 1844.

The ability of the people who settled Delaware was equal to its abundant resources. First came the Dutch, skilled in seafaring, thrifty farmers, and wise in the ways of trade. Then came Swedes, Finns, English, Scots, Irish, Welsh, and French Huguenots. All were earnest, energetic, with a strong sense of business and a stubborn love of independence. Their rugged character left a mark on Delaware history. They kept it a separate colony, with its own rights, despite stormy rule by three different nations. Cherishing liberty, they discouraged slavery even before 1700, and were leaders in providing jury trials for Negroes.

With the decline of sailing ships and the spread of railroads, soon after the Civil War, commerce waned. But the people of Delaware sturdily pursued their own way in a changed world. Industrial Wilmington became a large modern city, but its people still find time for friendly courtesy and warmth. They are proud of their "peaceful little state." Many return to family towns and villages for summer reunions. Lower Delaware turned almost exclusively to farming. There, until recent years, roads were poor, and the isolated villages and farms kept their old customs. Yet in essential matters like education Delaware has shown a soundly progressive spirit.

Agriculture Is the Chief Industry

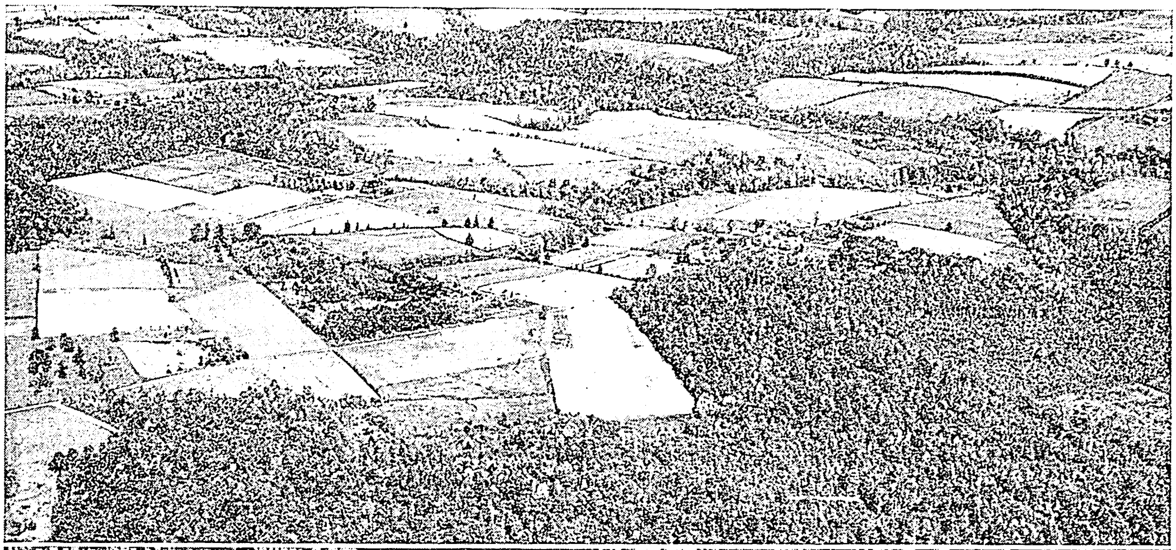
Rural Delaware lies near the heart of the greatest metropolitan area in the United States. A third of the nation's people live within 250 miles. This gives Delaware farmers ready markets with low shipping costs. They send their produce to Washington, Baltimore, Philadelphia, New York, and scores of smaller cities.

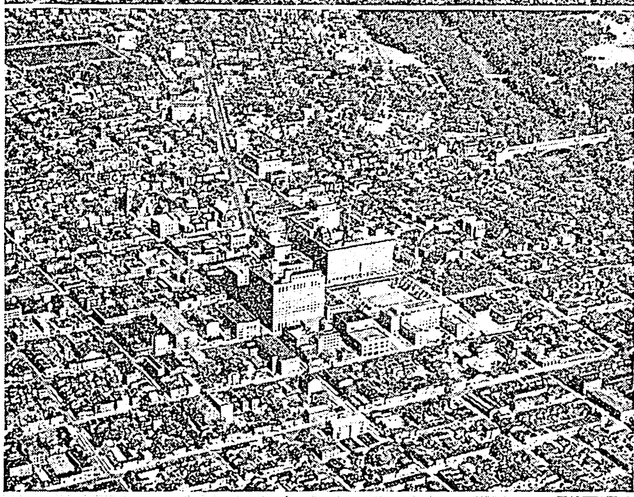
About 70 per cent of the land is in farms. The average holding is about a hundred acres, and about two-thirds of the farms are worked by the owners. Both soil and markets encourage diversified crops, which tend to prevent widespread distress in times of depression. Corn and winter wheat, grown chiefly in the silt loam of New Castle County, are the leading field crops in value, followed by alfalfa, hay, oats, rye, soy beans. The sandier loams of Kent and Sussex counties favor vegetables and fruits. In April the country is so lovely with massed pink and white blossoms of apple and peach trees that motorists tour the region on special state-marked trails.

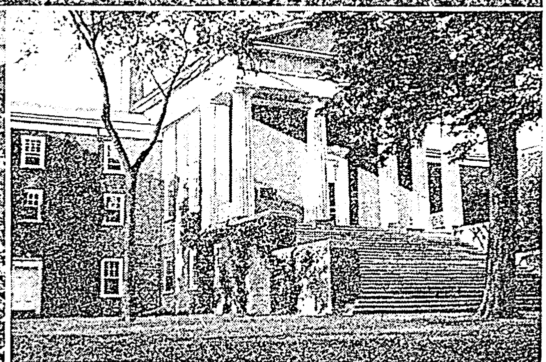
Nearly every small town has a canning or fruit-packing plant. These are busy from late April through autumn. First come asparagus and early peas; then in May and June, the strawberries; then starting about July 1, the early apples and tomatoes; and in August, the cucumbers and cantaloupe. With New Jersey, Delaware usually leads in the production of lima beans. Sweet potatoes, another major product, thrive in the sandier soils. Those offered at Christmas or Easter are likely to be from Delaware, for the farmers "kiln dry" most of the crop for sale on the off-season markets. Dairying and poultry raising are also important. Sussex is one of the nation's chief counties in production of broilers.

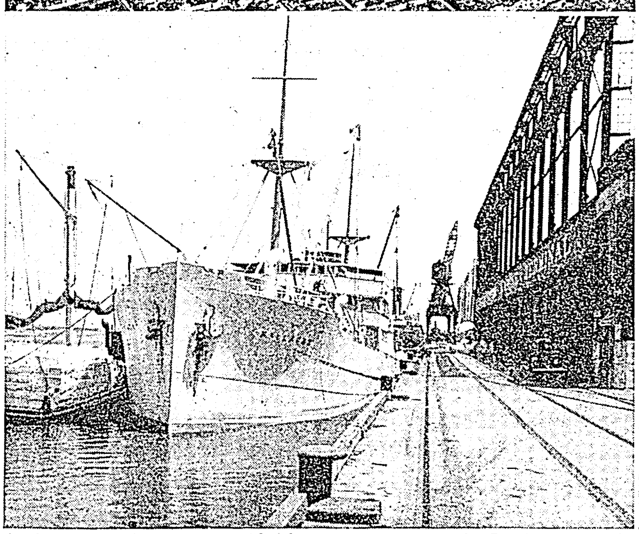
The farmers foster demands for their products by taking steps to keep quality high. Apple growers obtained a state law requiring closed packages of apples to be marked with the owner's name, address, variety, and grade of fruit. Cantaloupe growers sponsored the law that forbids shipment of immature cantaloupes from the state. Agricultural societies have existed since 1804, when New Castle farmers banded

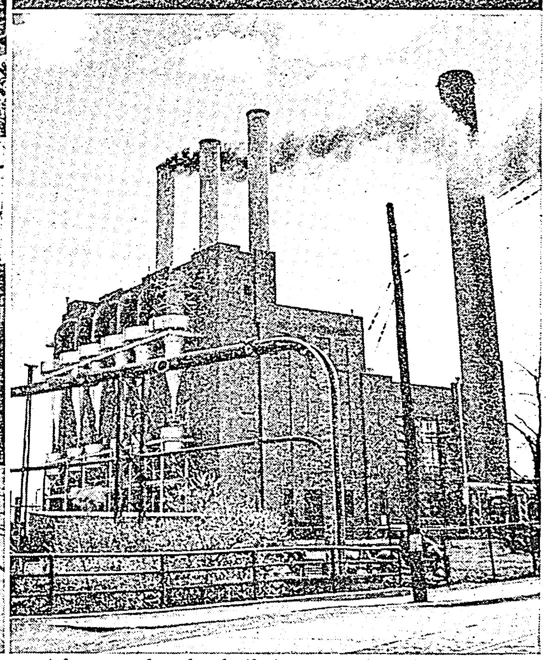
A CAMERA SURVEY OF DELAWARE











Agriculture is Delaware's chief industry. The nearly flat land and the neat farms and orchards that occupy about 70 per cent of the total area are illustrated in the Fairchild aerial view at the top. In another of these air views (center left) we look out over Wilmington, center of commerce and home of half the state's population. Ocean vessels tie up at the Marine Terminal (below left) in Wilmington's harbor on the Christina River, tributary of the Delaware. Dignified Old College (center right) of the University of Delaware at Newark was built in 1834 and is still in use. Delaware is one of the world's important centers for chemical research and manufacturing. The viscose plant shown here (lower right) is an industrial landmark.

together. The first state society was formed in 1849. These groups were largely responsible for teaching farmers to rotate crops and fertilize fields, thus restoring Delaware's celebrated fertility of soil. Today the state board of agriculture works closely with farm problems. The Division of Agricultural Extension of the University of Delaware and its county agents serve about 10,000 farmers. Its work also includes 4-H Clubs and home demonstration units. The Future Farmers of America and the National Grange are also widely active.

Manufacturing Is Varied But Minerals Are Few

In no other state is manufacturing more centralized. Over four-fifths of it is in New Castle County, chiefly in Wilmington. Nearness to the coal fields of West Virginia and Pennsylvania give Wilmington the advantage of a low cost fuel supply. Three trunk-line railways and the city-owned marine terminal, built in 1923, provide transportation facilities. The city's manufactures are varied. It is a leading builder of ships, railway cars, and articles from foundries and machine shops (*see* Wilmington).

Delaware no longer manufactures explosives, but the headquarters of the nation's three largest powder companies—E. I. du Pont de Nemours, Hercules, and Atlas—are in Wilmington. Just outside the city are the experimental laboratories of the vast Du Pont chemical industries. Vulcanized fiber, paper, and canned goods are produced at Newark, and Bellanca airplanes at New Castle, with rayon manufacture near by. The state has few minerals. Clay used in making terra cotta is the most important.

Highways Are the Backbone of Transportation

The state's excellent highway system has grown out of the famous Du Pont Boulevard, started in 1911 and completed in 1924. This concrete road was given to the state by Coleman du Pont, great-grandson of the founder of E. I. du Pont de Nemours and Company. The state highway department took control of all public roads in 1935, and Delaware became a leader in building concrete roads, dual highways, and express routes for trucks and in adopting safety laws for truck drivers, such as enforced rest periods.

Because of the large number of small individual shipments destined for near-by points, truck routes are today more important to Delaware than railroads. The state has less than 300 miles of rail lines. But the first regular steam railway passenger service in the country began in Delaware on Sept. 10, 1832, on the New Castle and Frenchtown railroad, built a year earlier.

The Chesapeake and Delaware Canal, opened in 1829, has become an important link in the Atlantic Intracoastal Waterway. Connecting Chesapeake Bay and Delaware Bay, it runs about 15 miles south of Wilmington. It is a sea-level channel, 250 feet wide and 27 feet deep.

Towns and Villages Recall History

Delaware is especially attractive to motorists, for nearly every town and village has its historic background. Even busy Wilmington is rich in early American memories (*see* Wilmington). Newark near by was one of the earliest junctions of cross-peninsula travel, growing up at the intersection of "two very Publick Roads." Here Mason and Dixon made their headquarters while surveying their famed boundary line. It is the seat of the beautiful University of Delaware. New Castle, oldest town in the Delaware River valley, was a leading port for settlers entering Pennsylvania, Maryland, and Virginia. Here William Penn landed in 1682 to become proprietor of Delaware. In 1776 it became the first capital of the state of Delaware. Its green was laid out by Peter Stuyvesant. The homes of several leaders in colonial and Revolutionary times still stand and are open to the public.

Dover, seat of Kent County and state capital since May 12, 1777, is near the center of the state, an hour's drive from Wilmington. Its wide shaded streets and gracious homes reflect the generous, dignified planning of the colonial period. In 1683 William Penn ordered Dover to be built. Kent County courthouse was built before 1697, the rest of the town laid out in 1717. In 1778 a visiting French nobleman wrote: "All the houses in Dover offered a simple but elegant appearance."

As early as 1673 Lewes, site of the first settlement in Delaware, was a bustling port. Today, as the home of many Delaware river pilots, it retains its proud tradition as "the saltiest town in Delaware." Behind its Delaware breakwater, begun in 1818, and its outer Harbor of Refuge, ships still take shelter from Atlantic storms. It is a center of salt-water fishing. Five miles south of Cape Henlopen is Rehoboth, "summer capital" and largest seaside resort. Surrounded by the holly trees and the loblolly pines of Sussex County, it is a favorite resort of Washington residents. The chief ports and shipbuilding towns of early days included Milford on the Mispillion, Seaford on the Nanticoke, and Odessa on the Appoquinimink.

Cultural Heritage and Education

Delaware's first notable literary figure was John Dickinson (1732–1808), "the penman of the Revolution," who came to the colony from Maryland in 1734. His political writings helped to persuade the colonies to adopt the Constitution. John Lofland (1798–1849) was an eccentric physician-writer whose prose and poetry on Delaware themes won him local distinction as the "Milford bard." Howard Pyle (1853–1911), famed writer and illustrator, worked chiefly in Wilmington, his birthplace, and his studio is preserved. Other distinguished writers include Christopher L. Ward (born 1868), Henry Seidel Canby (born 1878), and John P. Marquand (born 1893).

Delawareans prominent in other fields include John Bassett Moore (born 1860), jurist and historian; and Annie Jump Cannon (1863–1941), eminent astronomer. N. C. Wyeth (born 1882), a nationally known illustrator, was a pupil of Howard Pyle.

Education has advanced swiftly after years of setbacks. As the first Swedish colonists prepared to sail

in 1637, the king urged that they be provided with an adequate number of "ministers and schoolmasters." But the first teacher, Evert Pietersen, did not arrive until 1657 when the Dutch had control. As the colony grew, the prosperous sent their children to Philadelphia, New England, or abroad to school. In 1796 the legislature established a public school fund. But no use was made of it until 1817, and progress was negligible until 1829, when districts were empowered to establish free schools. Free education lagged, and in 1918 Delaware by prevailing educational standards was ranked below the average for the nation. But in 1919 the state, aided by contributions from private individuals, notably Alfred I. du Pont and Pierre S. du Pont, began a program of modernization that lifted it to rank among the first ten states, and among the first five of the predominantly rural states.

The University of Delaware grew out of Newark Academy, founded in 1743 near New London, Pa., and moved in 1767 to Newark. In 1843 it became Delaware College, and the University of Delaware in 1921.

WHERE COLONIAL LAWS WERE MADE

Assemblies met in the "Old Court House" in New Castle, perhaps as early as 1704. Its white cupola is the center of the "12-mile circle" that shaped the arc of the state's north boundary.

How Delaware Is Governed

Delaware's constitution, adopted in 1897, is its fourth. The others were adopted respectively in 1776, 1792, and 1831. Amendments to the constitution need no ratification by the voters. The General Assembly meets on the first Tuesday in January in odd years. It is made up of 17 senators, who are elected for four years, and 35 representatives, who serve for two years. The governor, elected for four years, may not serve a third term. Other executives also serve four years, except the treasurer and auditor, who are elected for two years.

Counties are still divided into "hundreds," a political unit used by the Anglo-Saxons. The pillory was not abolished until 1905, and the whipping post is still used to punish certain crimes. "Blue laws" prohibiting "unnecessary work" on Sunday, though long disregarded, were not repealed until 1941.

The state is the official home of many of the largest corporations in the United States. Industries carrying on their work elsewhere are chartered here to take advantage of its liberal laws of incorporation.

First Dutch Settlers Vanquished by Indians

The chronology of Delaware begins with the establishment of a whaling colony. In 1629 patroons of the Dutch West India Company bought land from the Indians, stretching from Bombay Hook to Cape Henlopen. In the spring of 1631 the *Walvis* ("whale") brought 28 men, whaling equipment, and cattle from Hoorn in Holland to a site near present Lewes. They called the settlement Zwaanendael ("valley of swans"). A quarrel with the Indians ended in the massacre of all the settlers some time before 1632. For the next few years the river remained in the hands of its Indian masters. Of Algonquian stock, they called themselves the Lenni-Lenape ("the original people"). For it was their tradition that they had come long ago from the west to be the first settlers in this region. Explorers had praise for the Lenni-Lenape, and other Indian tribes respectfully called them "Grandfather." They formed one of the strongest confederacies. They were a tall, proud people, friendly, intelligent, and brave in a forthright way. They resented being called "Delawares" by the white men until they were told this was the name of a brave white warrior. It was the Delawares who, in 1682 and 1683, made treaties of friendship with William Penn and assigned him rights to the site of Philadelphia (*see* Penn, William). But the trickery of the Iroquois and of the white men weakened the Delawares. Unable to defeat them in battle, the wily Iroquois persuaded the Delawares to become arbitrators in the destructive Indian wars being waged throughout the East. At first they refused, because Indian wars had formerly ended only at the intercession of the women. The Delawares wanted no such pleading rôle. But the Iroquois shrewdly convinced them that this part could be handled only by a tribe with the most honored tradition of strength and courage. And so the Delawares laid down their bows and arrows and pledged to refrain from warfare and to act as peacemakers for the general good.

Delaware Indians Driven Out

When the Iroquois had thus "made the Delawares into women," they soon dominated them, about 1720, with the aid of firearms supplied by northern colonial traders. The second great blow at the Delawares came when Governor Thomas Penn defrauded them of land in Pennsylvania through the sly Walking Purchase of 1737. The Indians had originally sold to William Penn land extending "as far as a man can walk in three days." Penn in 1683 had walked off half of this—about 40 miles—at a normal pace. When the time came to measure the remainder, Thomas Penn hired an expert who managed to cover 86 miles in the additional day and a half. When the Delawares protested, they were driven out by the Iroquois at the governor's behest. Destitute and broken in spirit, they began their straggling drift westward to the Wyoming Valley in the Alleghenies, then to Kansas, Oklahoma, and Canada.

Swedes Make Permanent Settlement

Meanwhile a new era had begun for Delaware colony. The first Swedish people to come to America landed at "The Rocks," on the site of modern Wilmington, in March 1638. Led by Peter Minuit, who had originally been in the service of the Dutch and had built Fort Amsterdam at the mouth of the Hudson River, they built here Fort Christina, in honor of the young Swedish queen. They named the surrounding country New Sweden. More Swedes came in

1641, and with them some Finns. These hardy Finnish woodsmen were the first builders of those log cabins that were to become the typical frontier homes of American pioneers.

Struggles for Control of Colony

New Sweden's trade attracted ambitious Peter Stuyvesant, governor of New Amsterdam. In 1651 his Dutch warships defied the ill-armed Swedish forts, and he built Fort Casimir on the site of modern New Castle. In 1655 Stuyvesant broke the last traces of New Sweden's power, and for the second time Holland commanded Delaware. But in 1664 England conquered the Dutch colonies, and Delaware became part of the "Duke of York's Province," under grant of Charles II.

But the stalwart Dutch recaptured their lands in 1673. Their rule was ended the next year by the Treaty of Westminster, but not until they had established courts at Upland, New Castle, and Lewes. This laid the foundation for Delaware's later claim to be recognized as a separate colony.

Passing from one master to another failed to shake the people from their rugged, independent ways. William Penn landed in New Castle, Oct. 27, 1682, intending to include the "Three Lower Counties" in his patent for Pennsylvania. But Delawareans sent their own delegates to Penn's first assembly, Dec. 6, 1682, and by 1701 won a new charter entitling them to a separate assembly, which first met in New Castle in November 1704. Thenceforth Delaware, though administered by governors appointed by Penn, sent none of its laws to England for approval by the crown.

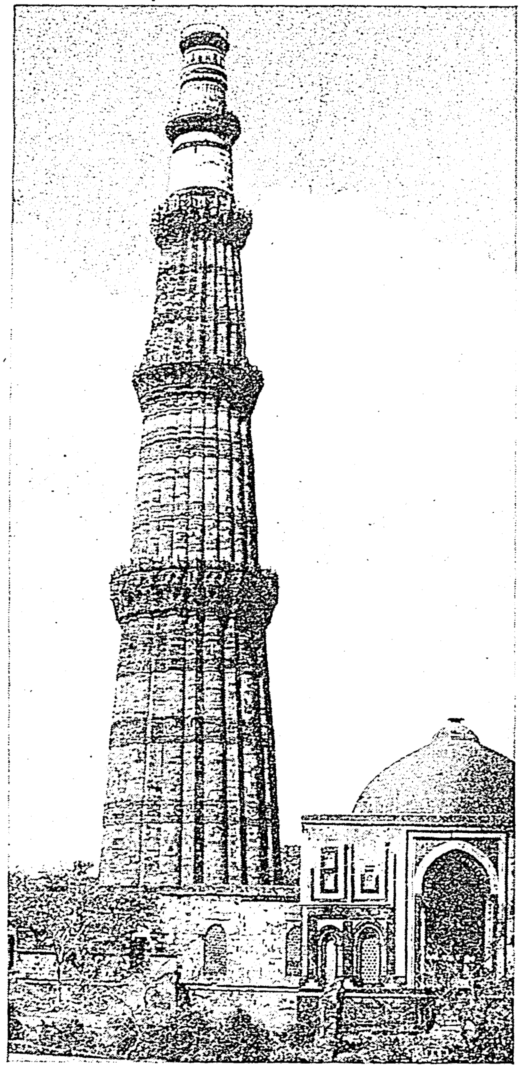
Delaware Fights in Nation's Wars

Although there were many loyalists in the little colony, Delaware was in the forefront of the fight for independence. The leaders were Caesar Rodney, Thomas McKean, and George Read, delegates to the Continental Congress. On the night of July 1, 1776, Rodney rode furiously from Dover to Philadelphia to vote with McKean, thus giving Delaware's support to the resolution calling for separation of the colonies from England. On Sept. 21, 1776, the three counties convened at New Castle to form the "Delaware State."

Nearly 4,000 of Delaware's population of only 37,000 enlisted in the Revolutionary forces. A celebrated company was that led by Capt. Jonathan Caldwell, whose men brought with them spirited game chickens from the brood of a blue hen in Kent County. These men fought with such valiant daring that they became known as the "Blue Hen's Chickens," thus earning for Delaware the nickname of the "Blue Hen" state.

Only one battle was fought on the actual soil of Delaware. This was at Cooch's Bridge, near Newark, Sept. 3, 1777, where some historians think the American flag was first unfurled in battle. In 1786 Delaware was one of the five states to send delegates to the Annapolis convention, of which John Dickinson of Delaware was elected president. Later at the Constitutional convention, Dickinson was a leader in supporting the proposals for a new constitution to replace the Articles of Confederation, and he insisted that the states have equal representation in one House of Congress. On Dec. 7, 1787, Delaware ratified the newly framed constitution. In the War of 1812 two Delaware leaders won outstanding victories. Capt. Jacob Jones, commander of the *Wasp*, captured the British warship *Frolic* in October 1812. In September 1814 Capt. Thomas Macdonough saved New York from invasion by defeating the British fleet on Lake Champlain. During the Civil War, Delaware sent some men into the Confederate army, but more than 13,000 served in the Union forces. About 10,000 served in the first World War.

DELHI'S "PERFECT TOWER"



The Kutb Minar near Delhi has been called the "most perfect tower in the world." It is 238 feet high and was begun about 1200 A.D. by Kutb-ud-Din, the slave who became an emperor. Those two oddly different top stories were rebuilt by Feroz Shah.

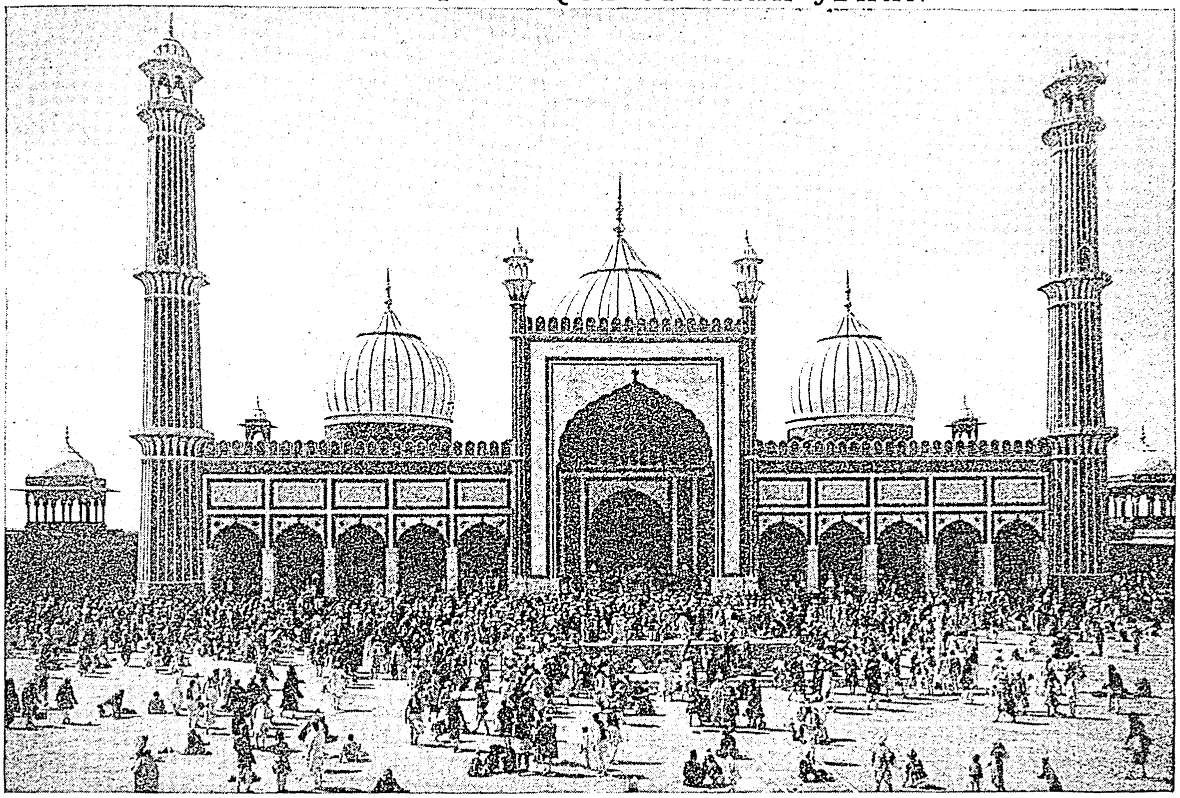
DELAWARE RIVER. Rising in two branches on the west slope of the Catskill Mountains, the united stream is formed at the New York-Pennsylvania boundary. For about 70 miles it forms the line between those states and then turns southward, separating Pennsylvania from New Jersey. Passing by Trenton, Philadelphia, and Wilmington, it empties into Delaware Bay, after a course of 360 miles.

Near Stroudsburg, Pa., the Delaware River flows through the famous Delaware Water Gap—a narrow gorge in the Kittatinny range of the Appalachians. The gorge is about three miles long, and the sides rise 1,400 feet sheer above the stream. The falls along the upper course of the river provide valuable water power. It is navigable for ocean-going vessels as far as Philadelphia and for lighter steamers as far as Trenton.

DELHI (*dĕl'ē*), INDIA. Chandni Chauk ("silver street"), the "Broadway" of India's capital, is a mile-long three-ringed circus of interest to the European visitor. A native bazaar stretches down its center, and both sides of the wide street are lined with the tiny "open-faced" shops common throughout the East.

Here are the booths of the sweetmeat sellers, where cubes and balls of coarse sugar are displayed in glistening copper pans. Near by is the tiny shop

THE GREAT MOSQUE OF SHAH JEHAN



This magnificent mosque, built at Delhi by Shah Jehan in 1650, is one of the largest Mohammedan buildings in the world. Situated on a small rocky eminence, its white marble domes and its graceful minarets are visible from afar. The great front court in which the crowd of worshipers is gathering is paved with granite and marble.

of the man who smears thick *pawn* leaves with lime and a red paste called *kutta,* adds chopped areca-nut, and with a little twist finishes the universal betel "chew" of India. Here too are grain stores where corn, wheat, rice, and millet are sold, along with spicy cardamon seeds and sweet oily sesame seeds. The barber, who also conducts a matrimonial bureau, chats without budging from his Buddha-like pose with his next-door neighbor the tailor. The *click! click!* of the sugar-cane vendor's shears, clipping off an anna's worth (about 2 cents) of inch-long bits, is almost drowned by the heavy *thud! thud!* from across the way, where gold and silver are being beaten into thin threads to be woven into the gorgeous scarfs—the *saris* and *chudders* of the rich.

Crowded streets, bobbing two-wheeled *ekkas* jostling a wedding procession, gesticulation, chatter, good-natured confusion; the clear round tones of money being rung to see if it be true or false; the mingled odors of frying *ghee* (clarified butter), burning cow-dung, and leather; half-fed thin bodies and faces always sober—such is the heart of native Delhi.

The lofty city wall incloses a maze of mean little streets, most of them crooked and narrow. Their squalid houses contrast pathetically with the regal splendor and limitless magnificence of the mosques and palaces of the former Mogul emperors at the east of the city and skirting the Jumna River, in a walled inclosure known as Delhi Fort. Here are some of the most splendid buildings in India.

The Pearl Mosque, one of the gems, is simplicity itself. Through heavy bronze doors, beautiful with bold arabesque, one enters a dreamland—white marble everywhere, the floor, the fountain in the center of the pool, the columns and arches, the exquisite frieze above. Its three pearly domes are surmounted by inverted lotus blossoms, out of which rise slender gilded spires, like gold beads.

The Diwan-i-Am, the hall of public audience, and the Diwan-i-Khas, the hall of private audience, are buildings of glorious splendor and beauty. Inscribed upon the cornice of the Diwan-i-Khas is the Persian text, "If there be a paradise on earth, it is this, it is this, it is this." In this hall of marble columns, gilded arches, and jeweled walls once stood the famous Peacock Throne (6 by 4 feet) on a base covered with gold and inlaid with diamonds, emeralds, and other rare stones. Over it was a dome-shaped canopy, supported by 12 columns and covered on its under side with diamonds and pearls. Above the canopy stood a jewel-encrusted golden peacock with outspread tail. When the Persian invader Nadir Shah sacked Delhi in 1739, he carried the throne to Persia.

Here too were once gardens and fountains, kiosks

and harems of pure white marble, beauty and gorgeousness without end, of which scarcely a vestige remains, much of it having been done away with to make room for the British barracks.

New Delhi, India's New Capital

During the Indian Mutiny Delhi was captured by the mutineers in 1857, and much of the city was destroyed during the five months' siege by the British which followed. The British base during the siege was the famous Ridge, a rocky height of some 60 feet about a mile outside the city. The Ridge was chosen in 1912 as the site for the new administrative capital of India, called New Delhi. Here a "garden city" was planned by Sir Edwin Lutyens, much as Major L'Enfant laid out the plans for the city of Washington.

Some 20 feet at the top of the Ridge was leveled off to form a plateau on which the three main government buildings were erected. Here stands the palace of the viceroy, or Viceregal Lodge; the Secretariat, and the Council or Parliament House. These main buildings are impressive in their classic style, with such oriental touches as domes and minarets cleverly combined. Broad tree-lined avenues lead from the government houses down to the residential section below. Here many homes have been built for or by government workers. The city's area of about five square miles was designed to care for an ultimate population of perhaps 65,000.

Since Delhi superseded Calcutta, in 1911, as the capital of India, it has recovered much of the prominence it had in earlier days as the capital of the Mogul emperors. Its central position at the southeastern corner of the Punjab (almost the same distance from the two great eastern and western ports of Calcutta and Bombay), with several railroads, and great thoroughfares along which pilgrims and caravans have traveled for centuries, gives it both commercial and political importance. There are many modern cotton mills and factories side by side with the ancient industries—gold and silver filigree work, jewelry, woolen fabrics, potteries, and wood-carvings, which have made the bazaars of Delhi famous.

Because of its ancient prestige, Queen Victoria chose Delhi as the seat of the great durbar (court) in 1877 when she was proclaimed Empress of India, and similar ceremonies were held at the accession of King Edward VII in 1903 and George V in 1911. Population, about 450,000.

DEL'PHI. In a gorge of lofty Mount Parnassus, overhung with towering cliffs, near the sacred fountain of Castalia—in the midst of perhaps the grandest and most awe-inspiring scenery in Greece, and (according to ancient belief) at the exact center of the habitable earth—was the famous oracle of Delphi. Here, it was believed, Apollo, the god of light, of poetry and music, and of prophecy, made known to men the will of Heaven; and here came inquirers from every part of Greece and from many other lands seeking his guidance.

In ancient days there was a cleft in the rock, whence issued volcanic vapors of strange potency. A priestess, known as the Pythia, having bathed in the fountain of Castalia and eaten of the leaves of the sacred laurel, took her seat on a tripod placed over the cleft, and inhaling the intoxicating vapors was thrown into an inspired frenzy or trance. The mystic words she uttered were taken down, put into verse form, and delivered to the inquirer as the revelations of Apollo. The oracles were usually expressed in obscure or ambiguous language and hence were capable of being interpreted in various ways. In the story of Croesus we read how such a response was given to this famous king before he went to war against the Persians (*see* Croesus).

No one who sought counsel at Delphi approached without gifts, and great treasuries were built to hold the offerings, often of pure gold or silver, presented by kings, states, and individuals. So many statues were erected that even after 500 of them were removed by the Roman emperor Nero, 3,000 remained. Recent excavations have laid bare the ruins of the great temple and many other buildings and many beautiful works of sculpture and thousands of inscriptions of historical value have also been found.

The oracle at Delphi was always consulted before any important step was taken by the ancient Greeks in affairs of state; and thus it exerted a powerful influence on the history of the Greeks. The common reverence for its utterances, and the Pythian festivals which were held at the shrine every four years, were among the chief influences making for unity in the political and religious life of the Greek world.

The Delphic oracle, though the most celebrated, was only one of several Greek oracles. The oldest was that of Zeus at Dodona, in Epirus, where Zeus was believed to speak through the rustling of the leaves of the sacred oak tree. There were also oracles in Rome, Egypt, Babylonia, and other countries.

DEMETER (*dē-mē'tēr*). The early Greeks were much struck by the yearly change of the seasons, from the joyous and fruitful summer to the bleak desolation of winter. They found the explanation in the stories which they told of the goddess Demeter. She was the sister of Zeus (Jupiter), king of the gods, and was one of the greatest of their deities. The Greeks called her "grain-mother" or "earth-mother," and worshiped her as the goddess of agriculture and of civilized life.

According to these stories, there was at first no winter but the earth smiled green and fruitful in perpetual summer. But one day, while Demeter's lovely daughter Persephone was gathering flowers in a meadow with her playmates, the earth opened and Hades (Pluto), the god of the dead, appeared and carried her off to be his queen in the world below. Demeter was inconsolable, and torch in hand she sought her missing child throughout the wide world. All that year not a stalk of grain grew, and man would have died of hunger if Zeus had not persuaded Hades to let Persephone go. Unfortunately she had eaten a pomegranate with Hades, and so could not stay

away forever. In the end it was arranged that Persephone should spend two-thirds of every year with her mother and the heavenly gods, and the rest of the year with Hades in the world of the dead. So, as a result of this arrangement, during spring, summer, and autumn earth blooms and bears fruit, and during the winter the life of vegetation sleeps buried underground. At Eleusis, in western Greece, the Greeks held an annual festival in honor of Demeter, with secret ceremonies. Those who were initiated into these Eleusinian mysteries found a deeper meaning in this myth. To them it held forth the promise of a future life beyond death.

The Romans worshiped Demeter under the name of Ceres, which gives us the word "cereal," and called her daughter Proserpina.

GOVERNMENT *by the* VOTES *of the* PEOPLE

The History of the Struggle among the Progressive Nations of the World toward Democracy and its Principles of Political Equality; the Many Methods that have been Devised to Make Popular Rule Effective

DEMOCRACY. The history of civilization begins in Western Asia and Egypt. When the mists which envelop this early history are blown away, we find that democracy or government by the people was almost unknown and that *autocracy*—the unrestricted rule of a single person—was virtually universal.

In the great oriental nations like Babylonia and Assyria, an absolute monarch ruled without any legal limitations of importance. He made laws by his own decrees; he had the power of life or death over his subjects. The only restraints which he felt were custom, the fear of arousing rebellion, and the power of the great nobles. Sometimes these rulers, like Sennacherib, were bloodthirsty and cruel; sometimes, like Cyrus, they were wise and mild. Even in the smaller nations, like the peoples of Palestine described in the Old Testament, autocracy was the rule.

In the more backward parts of the world some tribes or clans were organized in such a way that the heads of the families governed, but this was rare. Usually the people were ruled by a chief or a king, sometimes with the aid of a council of elders, and sometimes without; and the voice of the whole people was seldom heard. (*See* Family and Tribal Life.)

Democracy in Ancient Greece

The first dawn of democracy, in any important sense, occurred in Greece. Here in the dim past there arose a number of little city-states. These were tiny nations, whose territory seldom exceeded a few dozens or scores of square miles, and whose population was at first an association of family groups. Ten thousand free people was a large population for any of them. Hence the freemen could meet in a general assembly where every man could speak and vote. This was the simplest form of democracy, and representative government, in which one man speaks for many others, was unnecessary and unknown.

At first, in the age of Homer, these city-states were presided over by kings, but the kings had to pay careful attention to the opinion of the Assembly. After a time—in Athens as early as 700 B.C.—the kingship disappeared. The city then began to be ruled by the principal families. This form of government is called an *oligarchy*. But the people demanded a greater and greater share in the government, and democracy steadily gained strength. In Athens by the time of Clisthenes (about 500 B.C.) the people had gained practically full control. They elected their own magistrates, and made their own laws.

The Athenian Assembly

In Athens, which was the largest city-state in Greece, all final authority was placed in an assembly or *ecclesia* of the freemen. There laws were passed; generals and magistrates were chosen; and a great deal of the business of the state was transacted. There was a Council of 500 members, but its principal business was simply to prepare legislation for the Assembly to act upon. During times of peace, especially in the early days, the Assembly took great pains to prevent any one man from becoming supreme. Terms of office were kept short, seldom exceeding a year for any officer; the military power was usually divided among a number of generals, all equal in rank; and some of the principal civil officers were chosen by lot, so that the weakest citizen had as great an opportunity as the strongest. Political parties as we know them played no part in the government. The Assembly was a great school of oratory and of the art of managing large bodies of men, and Athens became known for its skilful political leaders.

When the leaders who gained the favor of the Assembly were able and upright, this democratic government of the Greek city-states worked well. Under a great man like Pericles (460–430 B.C.), or a just man like Aristides, the city-state prospered. But the Assembly at its worst was too much like a fickle mob, and it sometimes yielded to bad men like Cleon or to dangerous men like Alcibiades. The Greek system gave special advantages to the demagogue. Moreover, it lacked the power of healthy endurance. When a great monarchy arose in Macedonia, first under Philip and then under Alexander the Great, the democracies of Greece crumbled before its onslaught. (*See* Greece.)

Roman Struggle for Freedom

Rome also was at first ruled by kings. But as the city grew, its population came to include many outside of the original tribe which had founded it. These outsiders were denied political equality and other rights. The result was a series of struggles in which the people demanded a fairer and more democratic

form of government. The kingship was overthrown in 510 B.C. Thereafter, two consuls were chosen each year by an assembly of all the fighting men, the *comitia curiata*, to administer the laws. But even then the government was not a true democracy, for most of the members of the *comitia curiata* were "patricians" (the wealthy classes). The *comitia curiata* divided its power with the Senate, which was a smaller body of the aristocracy, each member holding office for life.

The common people of Rome, the *plebs*, made determined efforts to widen their rights of self-government, and gained some victories. Beginning in 339 B.C. the popular assemblies held for a period the full right of making laws. But Rome never achieved as much democracy as Greece. The Senate clung tenaciously to its power, and during the long struggle against Carthage—the Punic Wars—it became much the most powerful body in the nation. The senators controlled foreign affairs, the army, and the finances, and they really ruled as an oligarchy. Gradually the republic decayed. As the Roman armies conquered more of the world, powerful military commanders arose who held the supreme authority in the state. The Senate was naturally jealous of these commanders. But, finally, the greatest of them, Julius Caesar, overthrew the senatorial power and established the Empire. Except in the German forests and other wild areas, democracy appeared dead. (*See* Roman History.)

The Free Cities of the Middle Ages

Centuries passed before it revived again, for in the early Middle Ages democracy as we know it remained practically unknown. The rise of feudalism meant the rise of an aristocracy. Men yielded obedience to noblemen who had inherited their authority, or gained it by war and conquest. (*See* Feudalism.) But gradually a spark of democracy in the towns and cities of Western Europe began to kindle into a little blaze. These towns, in England, France, and Germany, were at first usually governed by some feudal lord or great churchman. But many of them came to be filled by artisans and merchants who were intent upon peaceful trade and money making, not upon war. In city after city the tradesmen and workmen began demanding charters to guarantee their political and economic rights. The kings, noblemen, and abbots struggled in vain against this trend, for the determined citizens always won.

By 1250, there were towns all over Europe which were wholly or partly free from their old feudal lords, though not from the kings; and they had gone far on the road of true democracy. Their qualified citizens, the burghers or burgesses, elected aldermen who made the laws and mayors who enforced them. But there was one important difference between most of these medieval cities and those of the modern world. The individual merchant, iron-worker, glassmaker, or weaver counted for little; it was his trade or calling that was important. In the typical free city of this period the government was based upon the different trades, or industries, such as the merchant gilds, and the various craft gilds, not upon wards or other geographical divisions (*see* Gilds).

Rise of Democracy in England

It was in England that democracy reached its fullest development. The English people had inherited some striking democratic institutions from the Teutonic invaders who had colonized Britain. In the very dawn of history these Teutonic tribes are found governing themselves in village communities by meetings of all the freemen. In England, such self-governing communities in early times combined into "hundreds," which were governed by a "hundred-moot" or meeting, made up of the priest, the reeve (steward), and four men from each township in the hundred. Above this was a general "folk-moot," a tribal or national council. In time, all England became a single Saxon kingdom, and the king was then assisted in ruling by a select national council of the chief men, called the "Witenagemot."

After the Norman conquest the towns rapidly became important, and the old Teutonic spirit of democracy revived in them. Henry I, who ruled 1100–1135, granted London a charter which was regarded as a model by other towns. Many of them demanded similar instruments, which Henry granted. After his death, Richard I, who was anxious to obtain money for his Crusade, sold charters to other municipalities.

The spirit of democracy in these places was alert and vital. In London, for example, special bodies of the citizens frequently came together in crowded borough meetings to elect aldermen, and in gild meetings to transact business for their trades. When the bell of old St. Paul's clanged loudly, they all met in a single great town meeting, with their aldermen presiding. Every townsman could claim the right to be tried by his equals in the town court or "hustings." When any danger threatened the city the townsmen mustered their own army, and delivered the banner to their chosen captain. As the years passed, the various town governments became as powerful as the noblemen who ruled great domains, or the churchmen who controlled many parishes.

Effect of Magna Carta

Meanwhile, there was a trend toward democracy in the English nation as a whole. By force of custom, law, or local charters, both the people and the noblemen, or barons, gradually obtained many rights. When King John, a weak monarch, tried to override them, the barons compelled him in 1215 to sign the Great Charter (Magna Carta). This protected the poor man in his right to justice and to his own property, while it also confirmed the privileges of the town. "Let the city of London," said the Great Charter, "have all its old liberties and its free customs, as well by land as by water. Besides this, we will grant that all other cities, and boroughs, and towns, and ports, have all their liberties and free customs." For centuries men looked back to the Charter of Runnymede as a landmark of English freedom. (*See* Magna Carta.)

Another great advance in democracy was made in 1265. There was already a parliament, but the only representatives in it were the barons, the bishops, and the knights of the shires. The knights had been summoned only occasionally since they were first called by King John in 1213. In 1265 Simon de Montfort, who was regent, called together a parliament in which the towns and boroughs were represented, each being entitled to two members. It was a "packed" assembly, but it marked a distinct turn in the history of parliament. A little later, in the "model parliament" of 1295, the representation of the towns was made permanent and regular.

By the middle of the 14th century, Parliament had separated into two bodies—the hereditary House of Lords (with the bishops), and the House of Commons, which was made up of town members and knights of the shires. The House of Commons was a great new instrument of democracy. (*See* Parliament.)

The Power of the Parliament

In other countries of Europe parliaments sprang up in much the same way. Each of the early kingdoms in Spain had a "Cortes," and members chosen by the towns sat in Leon as early as 1188. In France, there was a "States-General," in which the burgesses of the towns also had representatives. In Sweden, there was the "Riksdag," to which even the peasant farmers sent their own members.

But in none of these countries did the parliament become so important as in England. By the time of Cromwell, in the 17th century, the House of Commons had grown strong enough to overthrow the king and govern the whole country. A little later ministerial government was established; that is, government by men whom Parliament and not the king controlled. In the 18th century the House of Commons lost ground for a time. It was rather an aristocratic body than a democratic institution, and it fell under the influence of the king. But in the 19th century all this was completely changed. By a series of great reform acts culminating in the woman suffrage act of 1928 practically every adult person was allowed to vote for members of the House of Commons, and that body became one of the most truly democratic legislatures in the world.

American Democracy Founded

During the 19th century, democracy or "government of the people, by the people, and for the people," seemed to be sweeping the greater part of the civilized world. Even before the Revolution the English colonies in North America had highly democratic forms of government. Two of them, Rhode Island and Connecticut, governed themselves almost entirely and were among the freest communities on the globe. After the Revolution the United States rapidly rose to a preëminent position as a democracy. At first, the government had aristocratic features, but, in the time of Jefferson and still more in that of Andrew Jackson, the people established the principle that every grown man should have a vote, and the right to hold office.

American political philosophy and institutions were strongly influenced by the French. In France the revolution of 1789 resulted in the overthrow of the despotic Bourbons and the ultimate establishment of a democracy. Both the French and the American democracies took the form of a *republic;* that is, in the modern sense, a free, popular government in which there is no hereditary ruler or ruling class. Following the examples of France and the United States, most Latin American countries early in the 19th century became republics. But centuries of colonial subjection were poor training for self-rule and so, in some of these new republics, democracy was slow to develop.

As democracy spread, it was most commonly associated with the republican form of government. But the second type of democracy—the constitutional monarchy—also took root in some countries. In Denmark, Norway, and Sweden, as in England, the rulers abided strictly by constitutional restrictions of their power; and the freedom-loving peoples of those nations developed democratic institutions of the first order.

Years of Promise for Democracy

The chief stronghold of autocracy remained in central and eastern Europe. When the World War of 1914–1918 resulted in the defeat of Germany and Austria-Hungary, many hailed the peace as the opening of a new era in which democracy would everywhere prevail.

There were indeed many promising events to support this hope. In Germany and Austria the overthrow of the monarchy brought republics with democratic forms of government. As the vast Russian Empire disintegrated, there emerged the compact new republics of Finland, Esthonia, Latvia, and Lithuania. From the Baltic, south across the young republic of Poland, and into the traditionally despot-ruled Balkans, a new spirit of democracy appeared. Throughout the British Empire there was greater self-rule. Even in Asia democratic concepts began to spread.

Rise of Modern Dictators

But even as democracy was thus adding new nations to its fold, its way of life was being challenged by rival systems of government. In Russia the overthrow of the czarist régime brought a brief period of democracy; but a communist revolution in 1917 soon established a "dictatorship of the proletariat" (*see* Communism). In Italy the parliamentary system, attacked on all sides, finally succumbed in 1922 to the fascist dictatorship of Benito Mussolini (*see* Fascism). Other new democracies came under the sway of "strong men," who abolished all opposition and ruled as despotically as any king (*see* Dictatorship).

The full menace to democracy of these "totalitarian" systems did not become evident, however, until the National Socialists under Adolf Hitler took power in Germany in 1933. Swift action, rigid discipline, and construction of a great military machine—these enabled Germany to enlarge its power, while the democracies debated. When German expansion was finally opposed by force in 1939, Germany and its allies had,

within the first year of war, wiped out democratic rule in most of Europe (*see* World War, Second). The heart of democracy was now indisputably in the Western Hemisphere, with its 21 republics and Canada still firmly attached to the democratic way.

What Makes Democracy Work?

The quarter of a century from the outbreak of the World War in 1914 to the beginning of the European war in 1939 was a distinct epoch in the history of democracy. In the light of those eventful 25 years, many people were re-examining democracy in an effort to discover why it had failed in some countries and was a brilliant success in others. Several things at least seemed clear. First, that in order to maintain *political democracy*, there must be a large measure of *economic democracy;* that is, wealth must not be so unequally distributed that the people become discontented and thus fall easy prey to the glowing promises of demagogues. In Hungary and Rumania, for example, the poverty of much of the population was largely responsible for the failure of democracy. In the Scandinavian countries, by contrast, the absence of extremes, either of wealth or poverty, was the greatest safeguard of democratic institutions.

The second major requirement of successful democracy is a spirit of independence and self-reliance among the people, so that they will reject any attempt by the government to abridge their freedom to vote, speak, and write as they please. Education helps to develop this spirit, but even more important perhaps is the habit and practise of self-government. Thus, the backwoodsmen of the United States, with little education, developed a sturdy democracy. Yet among a people like the Germans, who were highly literate but who had scant training in self-government, the destruction of democracy was relatively simple.

Because democracy had vanished from so many countries by the close of the 25-year period following the World War, there were those who were quick to predict its doom. But in the remaining democracies there was a profound faith that it would not perish. Even among the peoples who had fallen under the rule of dictators there were many who were sustained by hope for its restoration. Wherever men and women are animated by a desire to control their own destinies, the spirit of democracy will remain alive.

Direct versus Representative Democracy

Self-government may take the form of *direct democracy* or of *representative democracy.* Direct democracy is government by all the citizens meeting together. The growth of population has made this impossible except for little units of local government. It exists in town meetings in parts of the United States, and in the assemblies of the Swiss cantons, but no modern nation can be ruled by direct democracy.

Of the representative democracies there are several types. One is the parliamentary democracy of Great Britain, and of Canada and the other British dominions. Another type is the presidential system which prevails in the United States and among South American nations. A third, as yet restricted to one country, is the executive council system of Switzerland. Each of these systems has its advantages and disadvantages, but the preference of the world in recent decades has swung strongly toward the parliamentary system.

Under the parliamentary system, which was invented in England, the government is carried on by a popularly elected legislature and by a cabinet which is in effect selected and dismissed at will by the legislative majority. Whenever the parliament changes its opinion upon any great issue, or whenever the country elects a new parliament of changed party complexion, one cabinet resigns and another is chosen. In this system, the will of the people usually finds immediate and vigorous expression. Moreover, it is adapted to bring able leaders to the front. In a parliament, the best orators and the most earnest and aggressive statesmen rise to be cabinet ministers. But the parliamentary system operates very clumsily where there are three or more strong parties, so that a cabinet finds it hard to obtain and keep a majority behind it.

In the presidential system the government is carried on by a legislature and president, who are largely independent of each other; the president is responsible not to the legislature but to the people, and he holds office for a fixed term of years. This plan produces greater stability and safety than the parliamentary system, for the president and the legislature tend to check each other. But such a government is often slow to act, and critics say that second-rate men, controlled by professional politicians, have a better chance than first-rate leaders of becoming president.

The Swiss Plan

Under the Swiss plan, there is a legislature elected by the people, which in turn chooses a small administrative council to execute the laws. This council is not a cabinet, for it holds office during a fixed term, and its members have no seats in the legislature. It occupies a position intermediate between the British ministry and the American president and his cabinet, though it is much less powerful than either. The Swiss plan appears to work well; but Switzerland is a small country, with an exceptionally intelligent people, no extremes of wealth or poverty, and few great problems. It is not certain that the same government would do so well in large and complex nations.

In all the great democracies, whatever their type, some common perils and difficulties have arisen. In all of them government has to be carried on by the aid of parties, and party passions and hatreds often rise dangerously high (*see* Political Parties). They cause unwise legislation, and sometimes even civil wars. Another danger is the evil use of money in popular government. Where there are great masses of voters to be reached, as in all large democracies, huge sums of money must be spent in political campaigns. Too often part of it is used for bribery or other improper purposes. Another defect lies in the difficulty of telling just what popular opinion is. In democratic self-government the will of the majority is sup-

posed to rule; yet when elections are held a great many confusing issues are often talked about at once, and it is hard to say just what the people have really decided. Perhaps the greatest danger of all is that in a democracy of tens of millions of people the government may get out of touch with the masses. The men who are elected to office may try to please bosses and machines instead of the public, or else try to please the voters with popular but unsound measures.

All these dangers can be met, but only by constant vigilance. And indeed, it is one of the great benefits of democracy that it tends to keep the people alert, to train them in self-reliance, and to make them realize that above all other guarantees must stand sound systems of education, so that they will know how to find and face real issues intelligently.

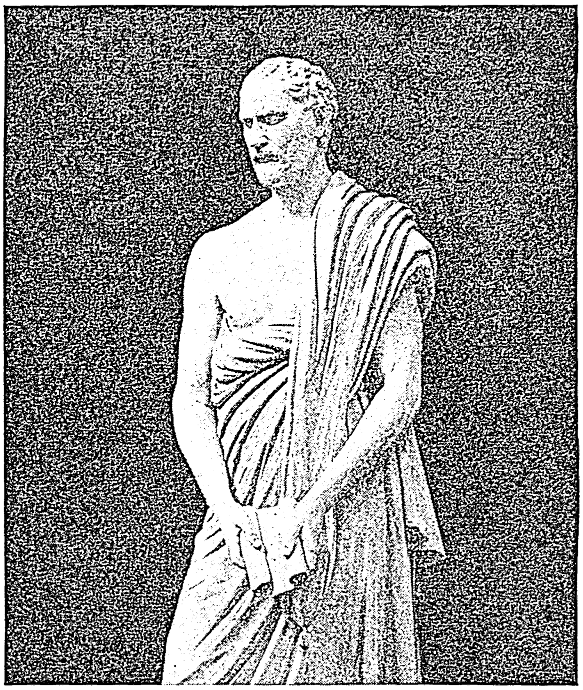
DEMOSTHENES (*dē-mŏs'thĕ-nēz*) (about 383–322 B.C.). If any of the Athenian friends of the youthful Demosthenes had foretold that he would become the most famous orator not only of Greece but of all history, the prediction would have moved those who heard it to derisive laughter.

"A great orator, indeed!" they would have replied. "Why, Demosthenes is the least likely lad in all Athens for public speaking. Look at him! He is a puny, spindling fellow. He is clumsy and awkward, and one shoulder is higher than the other. His voice is thin and weak, and he has an impediment in his speech. A great orator? Nonsense!"

But a great orator Demosthenes was determined to be, and a great orator he became. Even to this day, the student who wishes to master the art of eloquence studies the speeches of Demosthenes as the supreme masterpieces of any age. Perhaps one impulse that moved the young Athenian to entertain this ambition was the desire to obtain justice against his two cousins, who had mismanaged the goodly estate his father had left him, and had turned over to him only about one-seventh of what he should have received when he came of age. At any rate, Demosthenes did plead his case against one of his unjust guardians in later life, and won a verdict for damages.

When he first tried to speak in the public assembly, he was only laughed at. But Demosthenes had the kind of will that triumphs over all obstacles. To learn to articulate more distinctly, it is said that he practiced speaking with pebbles in his mouth; and to strengthen his voice he declaimed on the seashore amid the roar of the waves, or ran up hill as he recited. To overcome his awkward habit of lifting one shoulder higher than the other, he hung a sword so that it would touch his shoulder if he raised it. He fitted up a room in a cave, where he could study and practice without interruption. Often he sat up at night, writing and rewriting his speeches by the glimmer of an oil lamp. A man who was jealous of him once referred to this with a sneer, saying, "Demosthenes, your speeches smell of the lamp."

Success crowned his efforts, and Demosthenes at length rose to popularity and power, just at the time when a great danger threatened Athens. King Philip, who ruled Macedon, just north of Greece, was beginning those conquests which in the end made him master of Greece. Demosthenes, foreseeing the danger, urged his countrymen in one eloquent appeal after another to arise and preserve their freedom. His powerful orations against Philip were known as "philippics," and they became so famous that today any impassioned denunciation or criticism is called a "philippic."



DEMOSTHENES
"The Greatest Orator of All Time"

Only when it was too late did the Athenians heed the warnings of Demosthenes. Darker days followed for the great orator. The pro-Macedonian party, which had for its spokesman Aeschines, an orator second only to Demosthenes, obtained his condemnation on a false charge of taking a bribe. He was fined and thrown into prison, from which he fled into exile. When Alexander the Great of Macedon died, Demosthenes was recalled and led a last attempt to throw off the Macedonian yoke. Defeat put an end to the hopes of the patriots, and Demosthenes had to flee for his life. When overtaken by his pursuers, he begged leave to write a letter. For a few moments he was seen to chew a pen, as was his habit when writing or thinking. But in the hollow of that reed he kept poison for just such a crisis. Soon he began to tremble, and rising up, he tottered and fell dead.

Demosthenes' greatest oration, entitled 'On the Crown', was delivered in 330 B.C. It was a review and justification of his public life, in answer to the criticisms of his enemies, and is the most splendid example of ancient oratory that has come down to us.

STURDY LITTLE DENMARK *and its* PROGRESSIVE PEOPLE

Extent.—Area 16,568 square miles (11,408 in the peninsula of Jutland, the remainder in islands). Population, about 3,700,000.
Products.—Wheat, oats, rye, barley, potatoes, root crops; live stock, hides, and dairy products; cod, haddock, and other fish; porcelain, paper, wooden clocks, electrical equipment, automobiles.
Cities.—Copenhagen (capital, 665,000); Aarhus (90,000); Odense (75,000); Aalborg (50,000); Horsens (30,000); Randers (30,000).

DENMARK. A peaceful smiling landscape of gently rolling farmland, low hills, and dense forests of venerable beeches, wooded shores, and shallow lagoons, and always a view of the crisp blue waters of sea or lake, stream or fiord, dotted with innumerable little white-sailed boats—these are some of the pictures that linger long in memory after a visit to the little Scandinavian kingdom of Denmark. And as the dream pictures come back we recall the neat little villages with their single long cobbled street and their square-towered church; and the pretty little farms with low white plastered buildings topped by red-tiled or heavily thatched roofs, and likely as not a large stork's nest in the chimney, for the stork is very much at home here and seems to be Denmark's own bird.

These farm buildings are very substantial—almost never do you see a frame building of any sort in Denmark; and they are always built in the form of a square surrounding an inner courtyard. In front is the carefully fenced garden filled with a profusion of flowers, berry bushes, and fruit trees, and always a pretty little summer-house where the family enjoy their meals during the summer months, for the Danes love the out-of-doors and make the most of the short hot summer. Adjoining farmlands are rarely separated by fences since it has been found to be more economical in many ways to do away with these. The cattle are not permitted to roam in the pasture but are very carefully tethered. More often they are kept in their well-ventilated stalls the year around and the freshly cut clover is brought to them there, for the Danes have found that the cows give more and richer milk when they are not bothered by the flies and the hot sun of the fields.

Denmark proper occupies the peninsula of Jutland (slightly smaller than Maryland) and adjacent islands, the largest of which are Fünen (Danish *Fyen*) and Zealand (*Sjaelland*), lying between Germany on the south and Sweden to the north and east. To the west is the North Sea, on the east, the Baltic. The southern border of Denmark now extends through the middle of the province of Schleswig, since North Schleswig, after the World War, decided by a plebiscite, or vote of the people, to reunite with Denmark rather than with Germany, to which it was forcibly annexed in 1864. On the north and east Denmark is separated from the other Scandinavian countries by the shallow waters of the Skagerrak, the Kattegat, and the Sound.

IN OLD-TIME COSTUME

This market-woman of Amager, near Copenhagen, is wearing the quaint old national dress. Such costumes are now rarely seen, except in a few parts of Denmark.

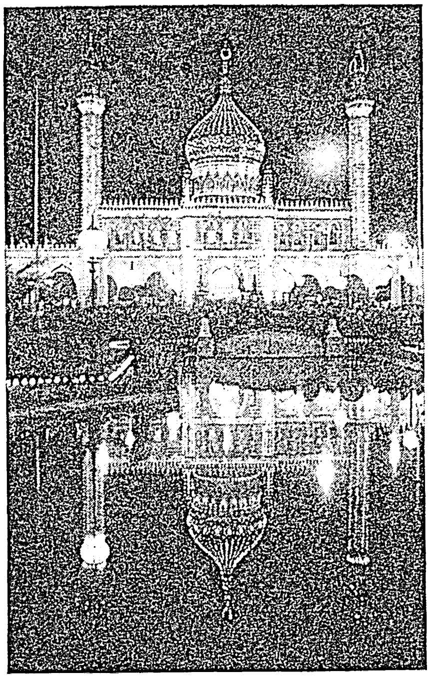
Fishermen and Farmers

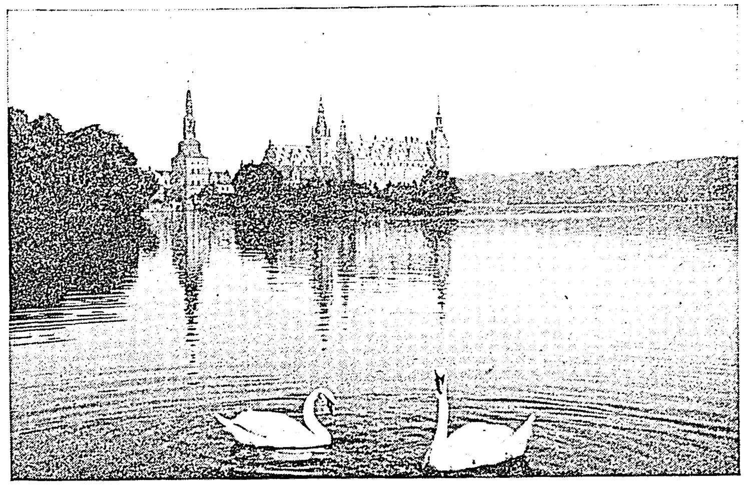
Since the peninsula is almost entirely surrounded by water, and has many fiords extending far inland, the fishing industry has been greatly developed. Almost the entire coast is lined with the nets and the neat little cottages of the fishermen. Fresh cod, salmon, shrimps, lobster, haddock, herring, and most of all the flounder, or plaice, are important in the Danish people's diet, and their export of fish has amounted to nearly $7,000,000 in one good year.

But agriculture is by far the leading industry. Two-fifths of the population are farmers and 80 per cent of the soil is productive. It is nearly all in the hands of small proprietors, because the law forbids the union of small farms into larger estates and encourages the parceling out of landed property. Extremes of wealth and poverty are therefore rare, and the spirit of the people is markedly democratic and independent.

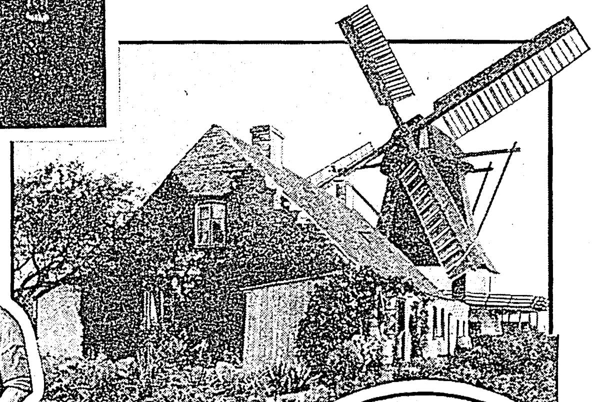
Though most of Denmark is a land of fertile fields and pleasant woods, well watered by the moist ocean winds, there are also large areas with a very different aspect; barren heaths and boggy moors and miles and miles of naked sand dunes. These regions are found in Jutland (Danish *Jylland*), whose west coast is battered by the strong North Sea winds. Here is a barren sandy stretch more than 200 miles long and in places over 6 miles wide. The wind is so strong that the sands are constantly shifting, the coast-line ever changing; no vegetation can get a foothold, and the few scattered peasants, as at Fanö, wear masks and tight head-dresses to protect themselves from the strong sandy blasts. The shallow wind-swept shores are so dangerous that sailors call this region the "iron coast." The only town of any importance is Esbjerg,

BOTH CASTLE AND COTTAGE ARE FAIR IN DENMARK





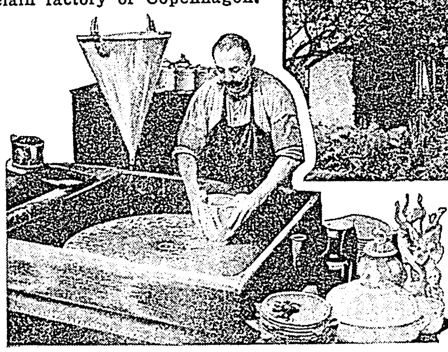
IN FREDERIKSBORG CASTLE, where swans skim the waters, the kings of Denmark have been crowned since the days of Christian IV. Built about 1602 near Hilleröd, it was damaged by fire in 1859 and restored by popular subscription.

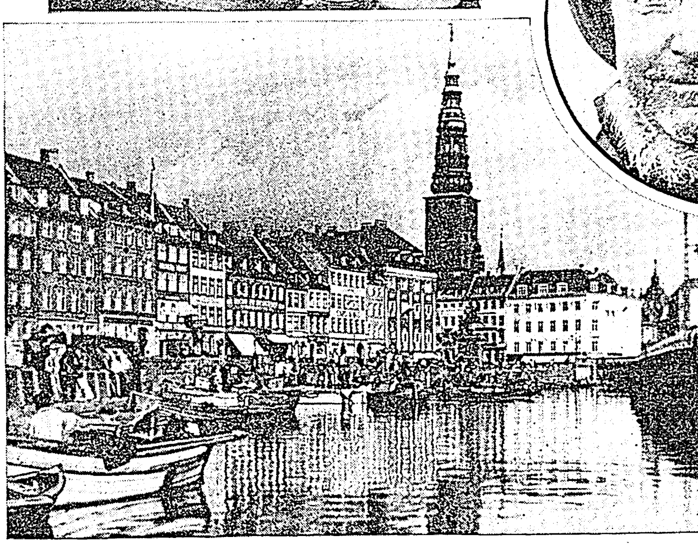


A FAIRY SCENE is the restaurant in the Tivoli, above, the recreational center of Copenhagen. Below is a potter in the grinding room of the royal porcelain factory of Copenhagen.

WINDMILLS ARE common in the old Danish duchy of Schleswig. This district and its neighbor Holstein have been claimed for generations by both Denmark and Germany.

RIGHTLY PROUD of their great sculptor, Bertel Thorvaldsen, are the Danish people. Below we see Thorvaldsen's portrait statue, leaning on his figure of 'Hope'. The piece now stands in the Thorvaldsen Museum in Copenhagen, which contains his tomb and most of his original works.





VETERAN of many battles with the sea is this fine old fisherman of Skagen.

SHINING WATERS of lakes and canals beautify Copenhagen. To the left we see the street of Holmens Kanal viewed from the Gammelstrand.

the chief port, from which immense quantities of bacon, butter, and eggs are exported.

This wide sandy belt extends to the northernmost tip of Jutland, where, at Skagen, it ends in a tiny tongue of sand curving out into the sea and losing itself between the waters of the Skagerrak and the Kattegat. A favorite theme of Danish poets is the beauty of Skagen, with its blue skies and clear air and its dunes of yellow sand washed by the restless sea.

Through the middle of Jutland, from north to south, stretch lonely windswept moors and heaths. Fifty years ago this area was a flat barren wasteland, but through the efforts of the Danish Heath Society more than half of the heath has been reclaimed. The people plowed up the heather and planted trees, dug canals, and drained marshes, so that now much of the heath is covered with fir trees and mountain pine. The pines yield an oil which is used in making soap and cosmetics.

Along the eastern coast of Jutland we find the typical Danish landscape of fertile fields and woods, cut through by many beautiful little lakes, streams, and fiords. Here are the highest hills of Denmark, all under 600 feet, and the main towns of Jutland, each at the head of its own fiord. Aarhus, the second largest city of Denmark, is the chief seaport and the chief town of Jutland.

A Land of Many Islands

East of Jutland, traveling by ferry across the waters of the Little Belt or by rail or car across the half-mile bridge built in 1935, we come to Fünen, the garden spot of Denmark. Its chief city, Odense, the third largest city in the country, is named from the Norse god Odin and is famous as the birthplace of Hans Christian Andersen.

Zealand, lying east of Fünen across the Great Belt, is the largest and most important of the Danish islands. It contains the capital of Denmark, Copenhagen, a bustling port on the Baltic Sea and the home of almost one-fifth of the Danish population. Copenhagen is the center of Denmark's large shipbuilding and automotive industries. (*See* Copenhagen.)

Linking Zealand with the southern island of Falster is the two-mile Storstrom Bridge, the longest bridge in Europe, which was completed in 1937. The bridge greatly increased travel across Denmark, since it made possible a continuous overland journey from the mainland to Copenhagen, with only one break, across the 25 miles of sea between northern Germany and Falster. On either side of Falster are the islands Laaland and Möen, and 100 miles to the east, rising abruptly out of the sea, is the rugged picturesque island Bornholm. Bornholm possesses the only considerable mineral resources of Denmark. It furnishes coal, building stone, and porcelain clay, and, although the island is stony, agriculture prospers.

Folk Schools and Coöperatives

For its reputation as one of the most democratic countries in the world, Denmark owes a large debt to Bishop Grundtvig (1783–1872), clergyman, teacher, writer, and founder of the Danish folk high schools. Believing that only through education could the people build democracy, Bishop Grundtvig inspired the creation in 1844 of schools for the study of Danish history, language, and song. Throughout the 19th century the schools, educating farmers and workers to understand their problems and take part in their government, played a vital rôle in developing Danish democracy. Today the folk schools, which are attended mainly by youths and adults from the rural districts, are still an important means of adult education. Workers' high schools are maintained by the Workers' Educational Alliance, with government support.

The coöperative movement, based on the collective effort of enlightened citizens, was one of the fruits of the folk schools. Since their foundation in 1866, the coöperative societies have grown increasingly until now they are the center of the agricultural life of the country. Almost every farmer belongs to several coöperatives, through which he borrows capital, buys supplies, and markets his products. They also teach him how to increase the quality and quantity of his produce by the most scientific methods of farming. The Danish coöperatives, which are among the most successful in the world, are largely responsible for the country's stability and prosperity. (*See also* Coöperative Societies.)

During the 19th century Denmark's chief agricultural product was wheat. When American competition and high tariffs wiped out the Danish market, the government, assisted by the coöperatives, shifted the agricultural economy to milk, eggs, bacon, and butter. These foods, particularly butter and bacon, found a ready market abroad, and Denmark became one of the world's largest exporters of dairy products.

History and Social Reforms

Denmark was for many years a leader in the movement toward social reform. In 1849 the country became a constitutional monarchy with legislative powers vested in the king and in a parliament (*rigsdag*), composed of an upper house (*landsting*) and a lower house (*folketing*). Before the 20th century, in advance of many other countries, Denmark had provided for old-age pensions, insured its citizens against sickness, and recognized labor's right to organize into trade unions. Almost everyone in the country belongs to the established Lutheran church. Education is compulsory and there is no illiteracy. The democratic character of King Christian X, who ascended the throne in 1912, was a major factor in the nation's record of steady reform.

When Europe was plunged into war in September 1939, Denmark, true to the tradition which had kept it at peace for three-quarters of a century, remained strictly neutral. But Germany, disregarding its non-aggression treaty with Denmark, invaded the little country, along with Norway, on April 9, 1940. At the behest of King Christian X, the Danes offered no resistance, and within a single day their entire country was occupied by the Germans. The Nazis permitted

King Christian to retain his throne and the normal forms of government to continue; but actually the German army of occupation ruled the country, and the Danes lost their sturdy independence, their democratic liberties, and their high standard of living. (*See also* World War, Second.)

THE DANISH PENINSULA AND ITS ISLANDS

It is a rich and pleasant land for the most part, this country of the Danes. From Skagen, "that tiny tongue of sand curving out into the seas," down through the lonely moors and heaths of Jutland, and throughout that group of great islands that nearly close the mouth of the Baltic, order and prosperity reign. The island of Bornholm, shown in the square at the lower right-hand corner, lies a considerable distance to the east in the Baltic. The map shows the portion of Schleswig which was reunited with Denmark after the first World War.

Denmark's history goes back to the dim twilight of the saga-period, out of which loom the figures of the Viking heroes. The Cimbri, a Teutonic people, had inhabited the peninsula about the beginning of the Christian era. From its base the Jutes and the neighboring Angles and Saxons had set sail in the 5th century to conquer England. The Danes are first mentioned by name in the 6th century; in the 9th and 10th centuries they were the most prominent of the "Northmen" whose Viking ships raided the coasts of Europe.

The missionary Ansgar baptized a Danish king in 826. Gorm the Old, who first united the islands and the mainland under one rule, opposed Christianity; but Canute his grandson, the conqueror of England (died 1035), was its zealous friend. During the reigns following that of Canute, the nobles grew powerful by means of the feudal system and ground down the once free people to serfs.

In 1397 Queen Margaret of Denmark united the three Scandinavian countries of Denmark, Norway, and Sweden, in the union of Kalmar, which lasted until 1523, when Sweden broke away. Denmark and Norway remained united until 1814, when Denmark was forced to cede Norway to Sweden by the Peace of Kiel (*see* Norway).

Fifty years later Denmark was attacked by Prussia and Austria and lost the provinces of Schleswig and Holstein, which had recently been incorporated in the kingdom. The northern third of Schleswig was returned to Denmark after Germany's defeat in the World War of 1914–18, but by a "plebiscite" (vote) of the inhabitants the second zone (about Flensburg) remained under German rule. Denmark's most picturesque people occupy the rugged wind-swept rocks that form the Faroe (from *faar*, sheep, or *fjaer*, feather) Islands, 700 miles north. Seventeen of the 24 islands are inhabited by descendants of Norse Vikings who settled there in the 9th century, and many Viking customs still prevail. Even the language commonly spoken, an old Norse dialect, is understood by few other Scandinavian peoples, although the official tongue of the islands is Danish. Violent wind storms prevent the growth of trees, but grass provides food for the sheep which are one of the main

sources of wealth. But the Faroe Islander "lives from the sea," and the drying of cod, the principal industry, is hurried during the brief 60 days or so of sunshine the islands enjoy each year. Wool working engages the natives in the long dark winter evenings. Whale meat and sea birds provide the main native diet—the cod is considered too valuable for home consumption, and is exported. Thorshavn is the islands' chief town. (*See also* Canute; Christian, Kings of Denmark; Copenhagen; Northmen; Scandinavia.)

—REFERENCE-OUTLINE *for Organized Study of* DENMARK—

ALTHOUGH their land borders on Germany, the Danes are more closely connected by race, customs, and history to Sweden and Norway. Denmark has few important natural resources, and foreign commerce is difficult because the low sandy shore has few harbors that will accommodate large ships. Her thrifty people, however, have made a remarkable success of dairy farming, and through coöperative marketing methods have built up a huge trade in butter and eggs, which are shipped to England and other near-by countries. In education Denmark ranks with the leading nations.

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DENTISTRY. Artificial teeth and gold mountings existed in Roman days, but the care of the teeth was crude, and it was not until the middle of the 19th century that dentistry became recognized as a separate and important science. Even for years after that dentists dealt chiefly with filling cavities, extracting teeth, and making "false" teeth for those who, through lack of care, had lost their natural teeth.

To the members of the profession in the United States belongs the honor of having first preached the all-important doctrines of dental hygiene, which includes the proper care of the teeth and mouth to prevent infection and decay. It is generally recognized today that many diseases are caused by germs which gain entrance to the body through neglected teeth and gums. An apparently healthy tooth, for instance, may have at its roots a painless abscess, which constantly infects the blood, causing inflammations of the bone or nerve sheaths, as in rheumatism, sciatica, etc.

The training of the modern dentist, therefore, requires more than mere mechanical skill. He must have a complete knowledge of the anatomy of the mouth, of the structure of bone and flesh tissues, and the diseases which affect them. He must be a competent surgeon in his field, and have a sufficient knowledge of general medicine to diagnose ailments which might be due to defective teeth. For special work, a practical knowledge of anesthetics and of the use of the X-ray is required.

So important has proper dental work become that many large cities maintain dental clinics where children particularly can receive the necessary care, and dental inspection is often carried out in the public schools at municipal expense. Attention to mouth hygiene has been proved to result in weight increase, higher disease resistance, better school attendance, more energy, and higher scholarship.

The degree conferred upon students who have completed the required course in dentistry is designated in most institutions as Doctor of Dental Surgery (D.D.S.), though some schools use the title Doctor of Dental Medicine (D.M.D.). (*See* Teeth.)

DENVER, Colo. To the east of Denver, Colorado's capital, the prairies stretch away to merge with the plains of Kansas. To the west and south, less than 15 miles away, the foothills of the Rockies turn suddenly into lordly mountains. From any high point in the city, you can see plainly several of the chief peaks of the Continental Divide, from Pikes Peak on the south to Longs Peak on the north. Denver's situation near this line which divides the great American plains from the Rocky Mountains gives it natural advantages which have made it the largest city between the Missouri River and the Pacific coast.

The site of the present city, the juncture of Cherry Creek and the South Platte River, was a favorite camping place for "forty-niners"—the adventurers who joined in the gold rush of 1849 to California. It became a regular settlement in 1858, when campers, delayed by the snow in the mountain passes, found "pay dirt" in the near-by hill streams. Ever since Denver has owed much of its prosperity to the wealth of mineral deposits in its guardian mountains. Later the city became an extensive distributing point, gained large manufacturing plants, and prospered by trade in farm and fruit products from the irrigated farms round about. It is the great live stock market of the Rocky Mountain region, a center of the sugar-beet industry, and a headquarters for oil and mining operations. It has foundries and machine shops, flour and planing mills, meat-packing plants, and car shops, and turns out clay, rubber, and canned goods besides.

The "Mile High" City

By reason of its altitude—one mile above sea-level—and its clear air, sunshine, and mountain scenery, Denver attracts many tourists and health seekers. It is a fine residential city, with many attractive homes on broad boulevards, excellent city parks, and some 10,000 acres of "parks among the clouds"—wild city-owned places in the mountains, reached by good roads.

Several important railroads serve Denver, and 1934 saw the institution of through service between Chicago and San Francisco via Denver. This uses the Moffat tunnel, six miles long, under the Continental Divide, 50 miles from Denver. This $18,000,000 bore was finished in 1928; but through service had to await completion of the 38-mile Dotsero cutoff connecting Orestod on the Denver & Salt Lake with Dotsero on the Denver & Rio Grande. Denver took the pioneer bore of the tunnel for an aqueduct.

Denver has a United States mint, and is headquarters for numerous federal bureaus and commissions. Much important work is done here by the Reclamation Bureau. The University of Denver, the Colorado Woman's College, Regis College, and the state university's medical school are in Denver. The state capitol's golden dome overlooks the civic center with its public library and open-air Greek theater.

The city took its name, when it was founded in 1858, from Gen. James W. Denver, governor of Kansas Territory, of which Colorado at that time formed a part. Population (1940 census), 322,412.

DES MOINES (*dē moin'*), Iowa. The center of a land of plenty; a thriving, progressive city in the midst of the world's greatest agricultural empire; an educational center and one of the industrial leaders among middle western communities—that is Des Moines, capital and largest city of Iowa and a monument to the solid prosperity of the region which it dominates.

Several railroads and interurban lines bear a rich freight to Des Moines—grain from Iowa's fertile soil to be milled into flour and other products; coal from the bituminous fields near by to supply fuel for the city's industries; live stock from Iowa's green pastures to supply packing house and tannery; wool to be fashioned into textiles and clothing. Smoke pouring from numerous stacks attests the growing importance of Des Moines as an industrial center, while the city's hundreds of miles of paved streets and electric car lines, its many beautiful public buildings, its famous park system, and its boulevards lined with comfortable residences indicate the wealth of the people.

Des Moines is a city of schools. In addition to its public school system, it has Drake University and several special schools. Its insurance business is extensive, with more than 50 home companies. Numerous farm journals published there disseminate information among farmers. It is the site of a United States Army post. The state capitol building, erected at a cost of $3,000,000, has won high praise as a noteworthy architectural achievement, and a splendid civic center is being developed.

Des Moines was settled in 1843, received its charter as a city in 1856, and a year later displaced Iowa City as the capital. In 1907 it adopted the commission form of government, known as the "Des Moines Plan." Population (1940 census), 159,819.

DE SOTO, Hernando (1496?–1542). A band of tired, hungry, and disheartened men stood, one clear spring day in 1541, on the banks of a great stream in the heart of the new American continent, a stream very deep and muddy and so wide that "if a man stood still on the other side it could not be discerned whether he were a man or no." They were Hernando de Soto and his followers, the first white men to see the inland course of the mighty Mississippi which rolled at their feet.

More than three years before, De Soto had obtained from Emperor Charles V as king of Spain an appointment as governor of the vast unexplored interior of southeastern North America—called "Florida" since Ponce de Leon's discovery a score of years before—with orders to subdue and to rule it. De Soto fully expected to find such fabulous riches as he had seen in Peru when he aided Pizarro in the conquest of that land; for there were rumors of a country so rich in gold that its king was completely gilded, whence he was known as "El Dorado" or "The Gilded One."

After staying for a time in Cuba, his company of over 700 men had landed, in May 1539, in Tampa

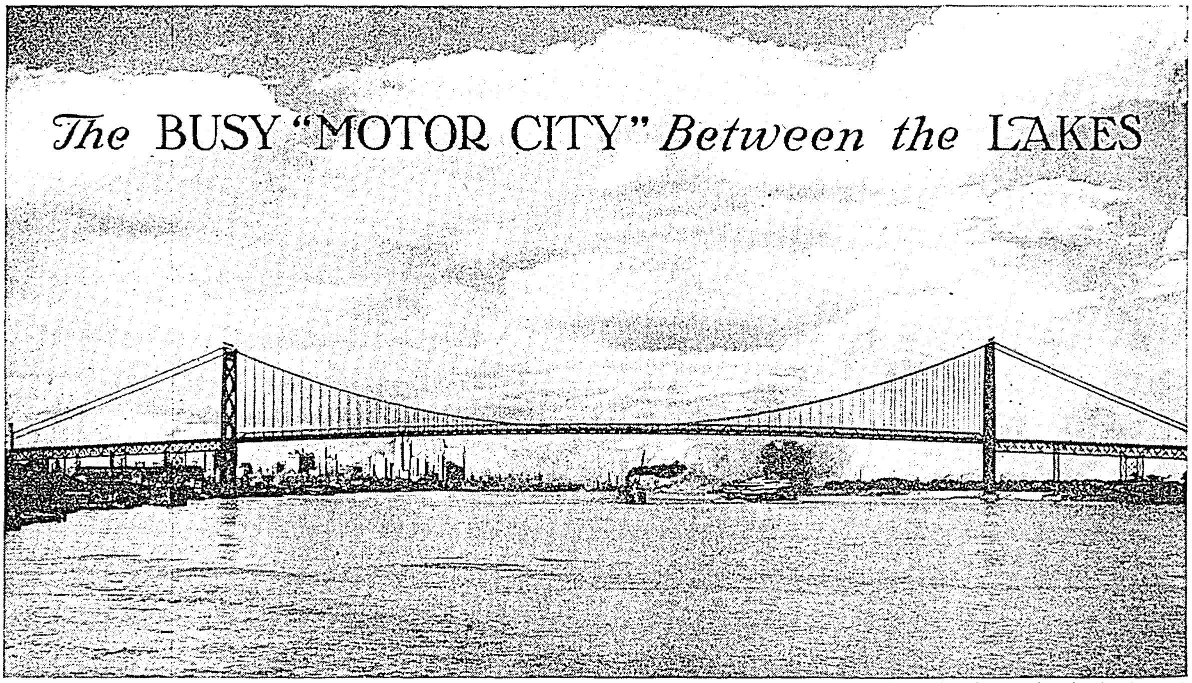
Bay, which they christened "Bay of the Holy Spirit." Captured Indians, loaded with collars and chains of iron, had guided the armor-clad explorers and performed the heavy work about the camp. But these Indian slaves proved untrustworthy, and the cruelty with which they were treated aroused the hostility of the tribes through whose country the expedition passed. Through dismal swamps and interminable pine forests, harassed by Indians, the ever-lessening company kept up its wearisome march through what are now the states of Georgia, Alabama, and Mississippi.

At last they had come to the banks of the Mississippi, just below the site of the present city of Memphis, Tenn. Still lured on by the will-of-the-wisp of fabulous wealth beyond, they built boats and crossed the swiftly flowing stream. On the other side they found other slimy bogs, dense cane-brakes, and thickets festooned with hanging vines, but nowhere a settled land and the riches of which they were in search.

Just as De Soto in despair had decided to abandon the country, he sickened and died (June 1542) on the banks of the great river he had discovered. His followers placed his body in the hollowed-out trunk of an oak tree, and screwed a plank over the opening. Weighting this rude casket with De Soto's heavy armor, they sank it one dark night in the turbid waters of the Mississippi, that the Indians might not know of the loss of their leader.

Those of De Soto's followers who were left—about 300—attempted to reach Mexico by land. But the Red River proved impassable, and so they turned back to the Mississippi. There they built seven frail vessels, and after a perilous voyage down the river and through the Gulf of Mexico they reached a Spanish settlement in Mexico, late in September 1542.

De Soto's expedition with that of Coronado, which was made at the same time, almost spanned the continent from the Atlantic to the Pacific. They had explored a vast territory in what is now the southern part of the United States, and had given Spain a claim to the whole interior of North America. (For map of route, *see* United States History.)



People may pass between Detroit at the left, and Windsor, Canada, either under, on, or over the Detroit River—that is, by tunnel, ferry, or the huge Ambassador Bridge shown here. This view looks northeast, with the heart of Detroit beyond the bridge at the left.

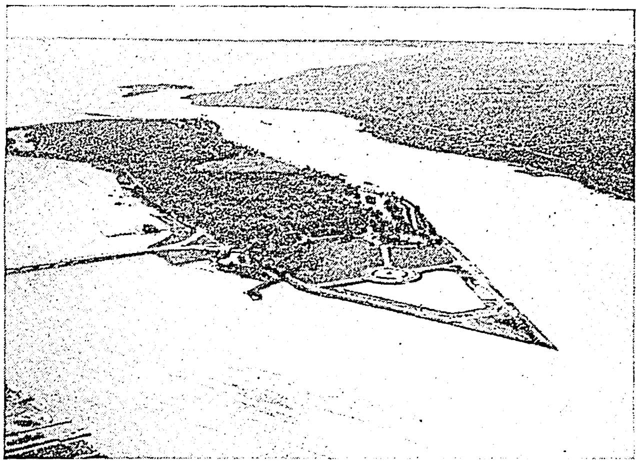
DETROIT. The fame of Michigan's chief city has traveled to the far corners of the earth on the wheels of the millions of automobiles that have rolled from its great plants. There can be few people in the civilized world who have not heard of Detroit and how the automotive industry pushed it in 20 years from 16th to 4th place among American cities.

This metropolis makes the lion's share of all the world's automobiles; and automobiles have made Detroit a metropolis. Most of the city's factories turn out automobiles and their many intricate parts. More than 200,000 of the nearly 700,000 workers from every land who have sought this mecca of skilled labor and high wages toil in the motor industry, and thousands more are in allied manufactures. The speeding cars that crowd the wide boulevards circling and crossing the city's 139 square miles were bought with automobile profits, wages, and salaries. It is the wealth from this industry that chiefly builds and supports the city's cultural, educational, and social institutions.

Pioneers in building "horseless carriages" as far back as the opening years of this century selected

Detroit as the center of the motor industry because there the waters of the Great Lakes are squeezed between Canada and the United States into the narrow strait of the Detroit River, making the city an ideal spot to assemble raw materials. Down Lake Huron come ore barges from Lake Superior's iron ranges, passing boats loaded with lumber from Michigan's deep woods, and ships full of foodstuffs from the middle western states. At Detroit's 11-mile water front they meet long barges of Pennsylvania coal shipped from Lake Erie ports. The 25-mile Detroit River carries more tonnage than any other river in the world, several times that of busy Suez Canal. A vessel every three minutes is the average during the navigation season. Many railways, truck lines, and airways add their share to the endless traffic.

DETROIT'S FAMOUS PLAYGROUND IN THE RIVER



This airplane view shows Belle Isle Park in the Detroit River, with Lake St. Clair and the Canadian shore in the background. The island is reached by the bridge at the left, and offers, among many other attractions, a zoo, an aquarium, and excellent boating.

French fur traders and missionaries first recognized the rich destiny of this site. Antoine de la Mothe Cadillac, soldier of fortune under Louis XIV, built Fort Pontchartrain here in 1701, and settled it with 50 soldiers and 50 colonists. England, spreading its power across the continent, eyed this stout fort greedily, and conquered it in 1760. From this base the British sent their Indian allies on bloody raids into the Ohio country during the Revolutionary War. The new-born United States was awarded this spot as part of the Northwest Territory by the treaty of Paris, but the British did not release it until 1796.

The little military and trading post, called Detroit from the French word for strait (*détroit*), became the capital of the newly formed Michigan Territory in 1805. It again fell to the British during the War of 1812, but the battle of Lake Erie returned it to the United States a year later.

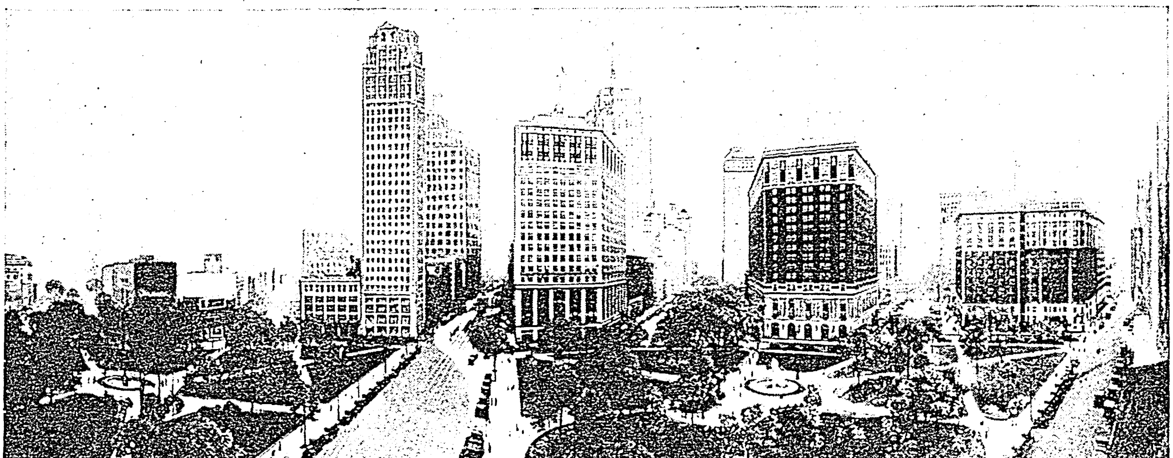
A fire in 1805 burned every house but one. Judge Augustus Woodward laid out a plan for the new town based on L'Enfant's plan of Washington, D. C. Wide streets radiated in a half-wheel from Grand Circus Park. The Campus Martius, Cadillac Square, and other small parks made green oases in the business district where skyscrapers now tower high above the trees. Territorial roads branched out in all directions making avenues which the motor age has widened into boulevards over which as many as six automobiles may drive abreast in both directions.

Population Doubled Every Ten Years

As Detroit grew—its population doubled every ten years for 100 years—it spread far beyond the original plan, passing the wide Grand Boulevard built to circle the city. It demanded more space because it aimed to give its millions a house and a bit of ground for a home, rather than to crowd them into narrow apartments. The fringing suburbs—particularly those on Lake St. Clair—are studded with magnificent estates.

River Rouge Park is the largest of the scores of parks in Detroit's recreation system. In the great zoo

ONE OF THE TWO "HEARTS OF DETROIT"



Here we look from north to south across Grand Circus Park encircled by hotels, clubs, and office buildings, and giving origin to streets running in every direction. Further south along Woodward Avenue (left center) is the heart of the business district.

far out on Woodward Avenue, each wild tenant finds a dwelling-place built to resemble its native home in forest or jungle.

Culture goes hand in hand with recreation in Detroit's plan for its workers, with their long hours of leisure and their high standard of living. An art center is growing around the nucleus of the richly endowed Art Institute and the city library. The library, planned by Cass Gilbert, serves more than 20 neighborhood branches. The civic orchestra ranks among the finest in the country; opera companies plan annual engagements; and visiting companies bring to the civic theater the best of the new dramas.

The city's progressive and thorough school system does not stop with high schools and junior colleges, but includes also Wayne University, which has a graduate school as well as colleges of liberal arts and various professional schools. Night schools aid in the Americanization of the men and women of 40 nations who have flocked to this great center of industry. The University of Detroit and other private institutions add to the educational opportunities.

Waterworks and street railways are owned by the city, which also makes the electricity for street lighting and street-car power.

Vast Wealth from Factories

Although the automotive industry was responsible for Detroit's rapid expansion, hundreds of other manufactures came to share in the advantages of the city's location and abundant labor supply. Iron and steel works were among the first. Engines, airplanes, machinery, stoves, foundry products, brass and copper, paint and varnish, chemicals, drugs, paper and printing, textiles, leather, rubber, lumber, and foodstuffs—all these were before long represented by industries turning out individually from $10,000,000 to more than $100,000,000 worth of products every year.

With the uprooting of the automotive industry after the United States entered the second World War, Detroit quickly converted its vast resources of machines and workers to making war planes, tanks, guns, and other munitions of war.

Detroit's population of 1,623,452 (1940 census) does not include thousands of suburban dwellers who work in Detroit plants and offices and shop in its stores. Hamtramck and Highland Park, independent cities entirely surrounded by Detroit, increased more than 1,000 per cent in population from 1900 to 1930. Each now has about 50,000 inhabitants. Dearborn has more than 63,000, and River Rouge has about 17,000. Many of Detroit's workers make their homes in Canadian border cities, crossing to Detroit by ferry, by the magnificent Ambassador Bridge, or through the $20,000,000 vehicular tunnel beneath the river.

DEUCALION (*dū-kā'lĭ-ŏn*). When the race of men, according to Greek myth, had fallen into evil ways so that Zeus destroyed them by a flood, Deucalion, son of Prometheus, and his wife Pyrrha, alone were saved. Deucalion built an ark or ship in which he and his wife floated during the nine days' flood which covered the earth. On the going down of the waters the ark rested on Mount Parnassus. To repeople the world, Deucalion and Pyrrha were told by the oracle to throw behind them the "bones of their mother." Interpreting this to mean the stones of mother-earth, they obeyed. From the stones thrown by Deucalion sprang up men, and from those thrown by Pyrrha sprang up women; so the earth was repeopled.

DEW. The warmer the air is, the more moisture it can hold. All through the sunny hours streams, plants, and trees are giving their share of moisture to the air by evaporation. When night comes the earth loses some of its heat through radiation; its surface feels cool and clammy to the touch. The layer of air just above the earth loses its heat too, and soon reaches a point at which it can hold no more moisture. The water is squeezed out of the air as it cools, and forms in tiny little globes as dew on any solid object. In the same way warm air deposits its moisture on the surface of a pitcher filled with ice-water.

Dew does not form readily on cloudy or windy nights, because the clouds act as a kind of blanket to prevent the earth from radiating heat into space, and because wind mixes warm air with the cool air near the surface. Thus the air is cooled more slowly, and if it does not reach the point at which it can hold no more moisture—the "saturation point" or "dew point" as it is called—no dew forms.

It has been noticed that dew forms more readily in valleys and in regions where there is much vegetation. Valleys are often filled at night with cold air that slides down the hillsides because of its weight. Aside from that fact, there is apt to be more dew in valleys because there is more moisture. Streams and vegetation together contribute more of it in hollows than on steep slopes, which are often bare or have scanty vegetation. The amount of dew is rarely more than an inch per year in a well watered region.

DEWEY, ADMIRAL GEORGE (1837–1917). On the night of April 30, 1898, six United States war-vessels moved boldly into Manila Bay in the Philippine Islands. The supreme moment had come in the life of Commodore George Dewey, then in his 62d year. When war between the United States and Spain had been declared on April 24, Dewey was in command of the Asiatic squadron off Hongkong, China. He had been ordered by cable to "capture or destroy" the Spanish fleet in Philippine waters, and had sailed under full steam, his vessels stripped for action. He now confronted the war-

GEORGE DEWEY
The Victor of Manila Bay

ships of the enemy, drawn up in front of Cavite Point.

Dewey faced his task with the confidence inspired by long training and experience. Born in Montpelier, Vt., Dec. 26, 1837, he had been graduated from the Naval Academy at Annapolis in 1858. During the Civil War he had served under Farragut in the battle of New Orleans and had taken part in two attacks on Fort Fisher. After the Civil War he had risen successively through the ranks of lieutenant-commander, commander, and captain, and finally as commodore he had been placed in command of the Asiatic squadron.

In the early dawn of May 1, the American warships, steaming in column formation, bore down on the Spaniards and opened fire. Within a few hours Dewey had completely destroyed the Spanish fleet, without the loss of a ship or of a man.

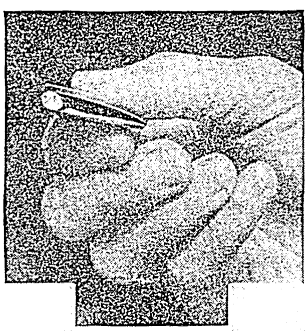
As soon as the news of this victory reached America, President McKinley appointed Dewey a rear-admiral, and before his return to the United States in 1899 he had been made admiral, a rank which had been conferred before only upon Farragut and Porter. It was also voted that Dewey should never be placed on the retired list of the navy; so that he was still considered in active service at the time of his death (Jan. 16, 1917), although he was then 80 years old. A house in Washington was purchased for Admiral Dewey by popular subscription. Although there was later some reaction from the hysterical worship which at first greeted his exploit, he enjoyed to the end of his days a well-earned popularity.

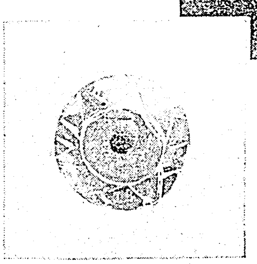
The SPARKLING CRYSTAL COUSINS *of* COAL

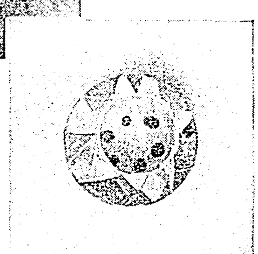
How the Great Diamond Industry of South Africa Grew out of a Child's Discovery—Why Diamonds are so Precious—Glittering Pebbles with Famous Names and Strange Histories

DIAMOND. One day some Boer children, playing on the banks of the Orange River in South Africa, found a very hard pebble that was brighter than any they had ever seen and they ran to show it to their mother. It was nearly white and resembled a piece of lump alum, except that it was extremely heavy. There were bright spots on the surface where the outer skin was rubbed thin and these spots shone as though there were a hidden light within. A few days later they showed it to a neighbor named Van Niekirk. He offered to buy it, but the children laughed at the idea and told him to "sell it and make his fortune."

IS IT A REAL DIAMOND?







Here are some interesting tests. If a diamond is genuine, its edges cannot be crushed between two coins. The way to make this test is shown in the middle picture above. This is because the diamond is the hardest known material in nature. Another test is to look at a black spot on a white card through a diamond, about a quarter of an inch away. If the gem is real, the spot is plainly seen, as in the picture to the left. If the stone is false, the spot appears as a ring of spots, as shown on the right.

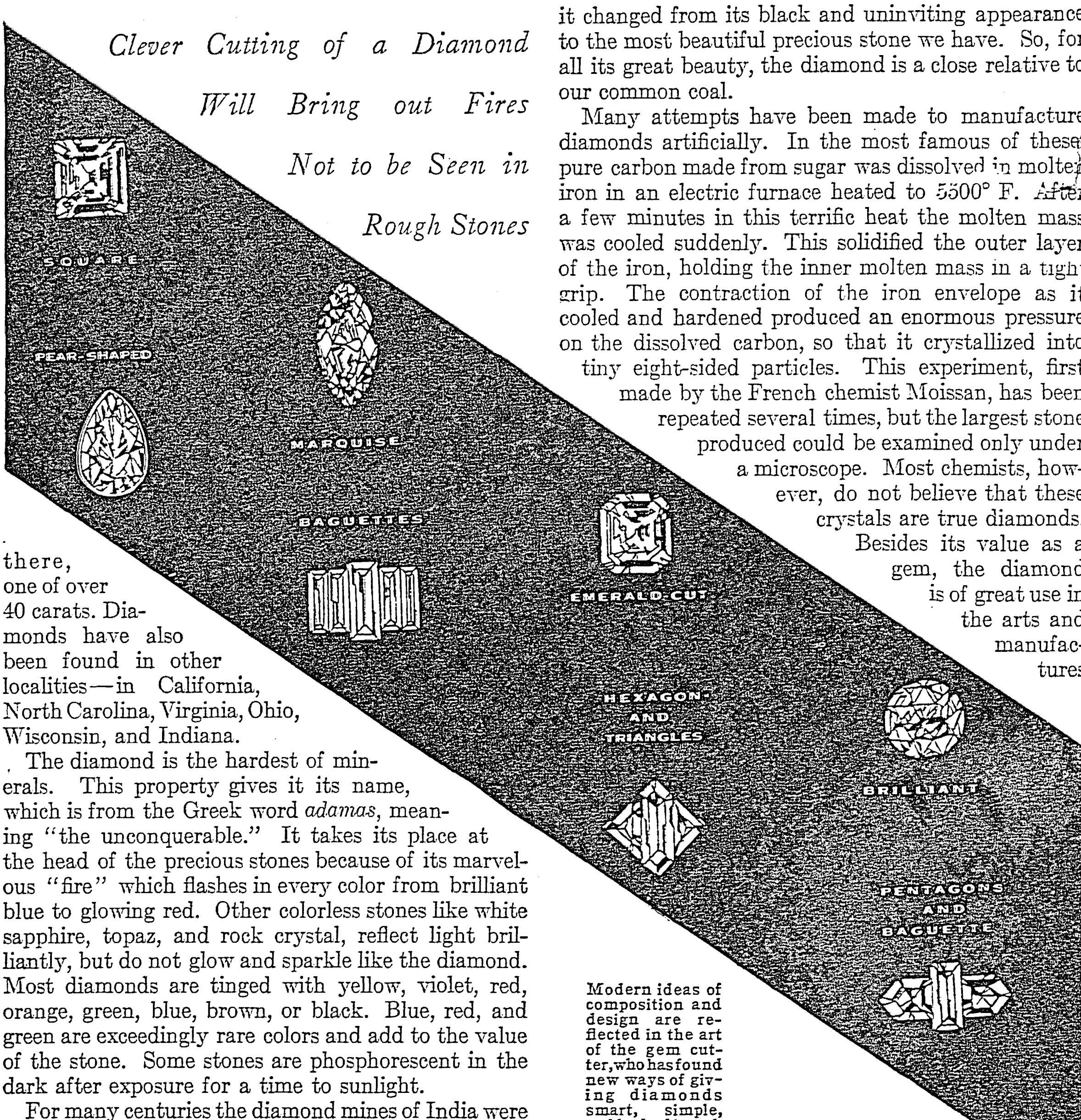
Van Niekirk took the stone to storekeepers in the towns near by, but they would not believe it was valuable. "It is a very pretty pebble," they said, "but who will pay money for it?" Finally he gave it to a trader to sell for him. The trader sent it to a government agent, who said it was a diamond weighing 21 carats. Most of the diamonds we see in rings are from one-half to one carat in weight, so you can see that a 21-carat diamond is very large and valuable. The governor of the colony paid $2,500 for it, and sent it to the Paris Exhibition of 1867.

People generally did not believe there were many diamonds in Africa. But Van Niekirk kept his ears open for stories of strange stones that were found, and two years later he learned that a poor shepherd boy had found an unusually large bright stone, which he carried around with him as a charm. Van Niekirk finally persuaded him to sell it for 500 sheep, 10 head of cattle, and a horse. This was unbelievable wealth for the poor boy, but it was not a tenth of the $56,000 that a Hopetown firm paid for it. It was a diamond of 83½ carats uncut and is now known as the Dudley diamond.

When these finds became known there was great excitement not only in South Africa but all over the world, and diamond hunters came from every corner of the globe. One great diamond field after another was brought to light, and the mines were found to be the richest in the world. For many years South Africa produced 90 per cent of the world's supply, but the Belgian Congo, Gold Coast, Angola, Sierra Leone, Southwest Africa, and Tanganyika have become important sources.

British Guiana and Brazil supply a large part of the remainder of commercial diamonds, although diamonds in small quantities are mined in Borneo, India, Dutch Guiana, Australia, Sumatra, China, and the United States. Pike County, Arkansas, has furnished most of the diamonds found in the United States. More than 10,000 stones have been found

Clever Cutting of a Diamond Will Bring out Fires Not to be Seen in Rough Stones



Modern ideas of composition and design are reflected in the art of the gem cutter, who has found new ways of giving diamonds smart, simple, well-defined lines. The designs above show both old and new styles.

there, one of over 40 carats. Diamonds have also been found in other localities—in California, North Carolina, Virginia, Ohio, Wisconsin, and Indiana.

The diamond is the hardest of minerals. This property gives it its name, which is from the Greek word *adamas*, meaning "the unconquerable." It takes its place at the head of the precious stones because of its marvelous "fire" which flashes in every color from brilliant blue to glowing red. Other colorless stones like white sapphire, topaz, and rock crystal, reflect light brilliantly, but do not glow and sparkle like the diamond. Most diamonds are tinged with yellow, violet, red, orange, green, blue, brown, or black. Blue, red, and green are exceedingly rare colors and add to the value of the stone. Some stones are phosphorescent in the dark after exposure for a time to sunlight.

For many centuries the diamond mines of India were the chief source of the world's supply, and some of the most beautiful and famous stones have come from that country. The Greeks, returning home after the invasion of India in 327 B.C., probably brought the first knowledge of the precious gem to Europe. The diamond was held in awesome reverence, for it was supposed to have magical powers, being able to cure sickness and to bring good or ill fortune to its possessor.

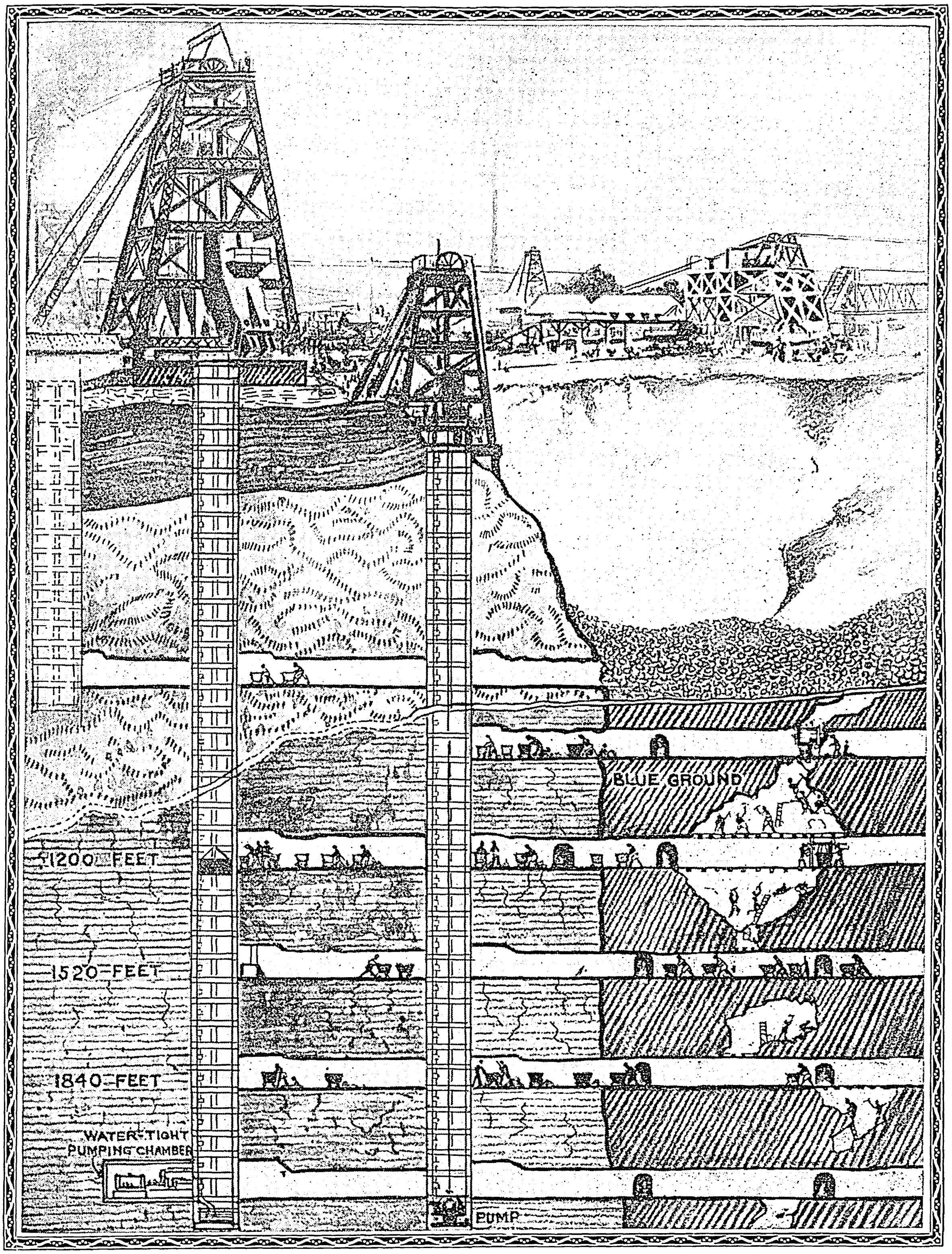
Scientists tell us that the diamond is crystallized carbon. And what is carbon? It is one of the most common materials in nature, one that exists not only in vast amounts in the earth but in trees and plants of every kind. At some time in the earth's history this carbon was changed to liquid by great heat and crystallized under enormous pressure, and in crystallizing, it changed from its black and uninviting appearance to the most beautiful precious stone we have. So, for all its great beauty, the diamond is a close relative to our common coal.

Many attempts have been made to manufacture diamonds artificially. In the most famous of these, pure carbon made from sugar was dissolved in molten iron in an electric furnace heated to 5500° F. After a few minutes in this terrific heat the molten mass was cooled suddenly. This solidified the outer layer of the iron, holding the inner molten mass in a tight grip. The contraction of the iron envelope as it cooled and hardened produced an enormous pressure on the dissolved carbon, so that it crystallized into tiny eight-sided particles. This experiment, first made by the French chemist Moissan, has been repeated several times, but the largest stone produced could be examined only under a microscope. Most chemists, however, do not believe that these crystals are true diamonds.

Besides its value as a gem, the diamond is of great use in the arts and manufactures because of its hardness. Diamond dust is used for polishing diamonds and other gems, and the natural edge of a diamond is used for cutting and engraving glass, steel, and other hard substances. Black diamonds from Brazil, called *carbonados*, and other small and inferior diamonds, called *borts*, are used as cutting points for rock-boring tools.

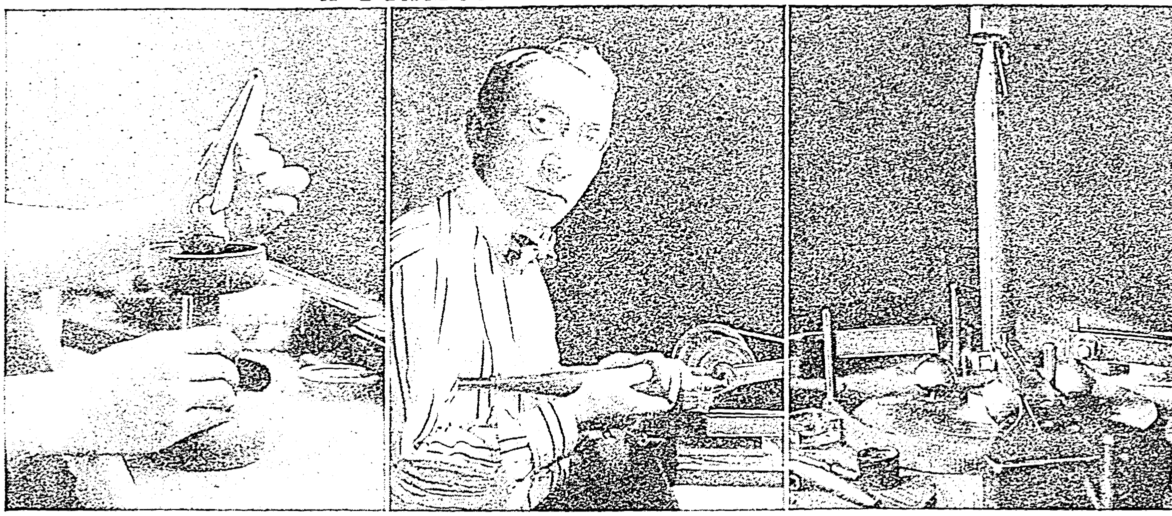
Before being used as jewels diamonds must be cut and polished, so that they will sparkle by reflecting back as much as possible of the light that falls on them. First they are split or sawed, if necessary,

MINING DIAMONDS IN SOUTH AFRICA



This is a cross-sectional view of a diamond mine in South Africa. Notice the elaborate pumping system that keeps it from being flooded. Kaffirs with picks and drills are at work on various levels digging out the kimberlite, or "blue ground"—a form of volcanic rock. Others are hauling it to the shaft, where it is hoisted to the surface in skips, and taken to the mill for crushing, sifting, and washing. After washing, only the heaviest particles remain. These are passed over inclined shaking tables of corrugated iron smeared with vaseline. The diamonds stick to the vaseline, and the waste rock is washed away.

A DIAMOND CUTTER AT WORK

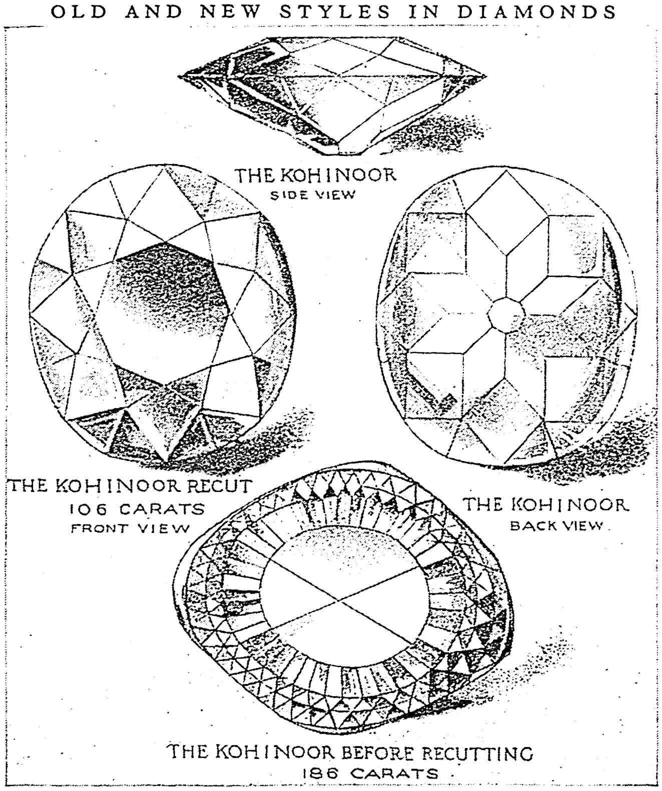


The picture on the left shows the diamond cutter's hands shaping the soft solder in which the diamond is mounted so that it may be held firmly while he is polishing it. The second picture shows the preliminary shaping. Three of the soft solder mounts (the small round balls) are shown in the last picture, where the diamonds are being held by heavy iron arms called tongs against a horizontal iron wheel which is revolving at the rate of about 2,500 revolutions a minute. A paste of olive oil and diamond dust is applied to the wheel from time to time. It is a case of "diamond cut diamond," as the saying goes.

then roughly shaped by another diamond mounted on a lathe. The facets are cut and polished by an iron disk carrying a paste of diamond dust and oil. The "brilliant" pattern has 58 facets, 33 above and 25 below. The "rose" pattern is flat below, with 12 to 32 facets above. It is sometimes necessary to lose half the weight of the stone in cutting and polishing, in order to obtain the greatest beauty and brilliancy. Several hours are required to cut a single facet, and the utmost skill is needed to keep the angles of the faces mathematically exact. Amsterdam and Antwerp are the centers of the industry, though many diamonds are cut in the United States.

The most noted historic diamond is the Kohinoor of the English crown jewels. There is a tradition that this beautiful gem was taken in 1304 from a rajah at Malwa, in whose family it had been an heirloom for centuries. It is believed to have been guarded with other treasures at Delhi until 1739, when it was carried off by the Persian Nadir Shah as part of his immense plunder. Finally it was surrendered to the East India Company, whose directors presented it to Queen Victoria. Its weight in its Indian cutting was 186 carats, but after recutting in London in 1852 the weight was reduced to 106 carats, although it gained immensely in brilliancy.

OLD AND NEW STYLES IN DIAMONDS

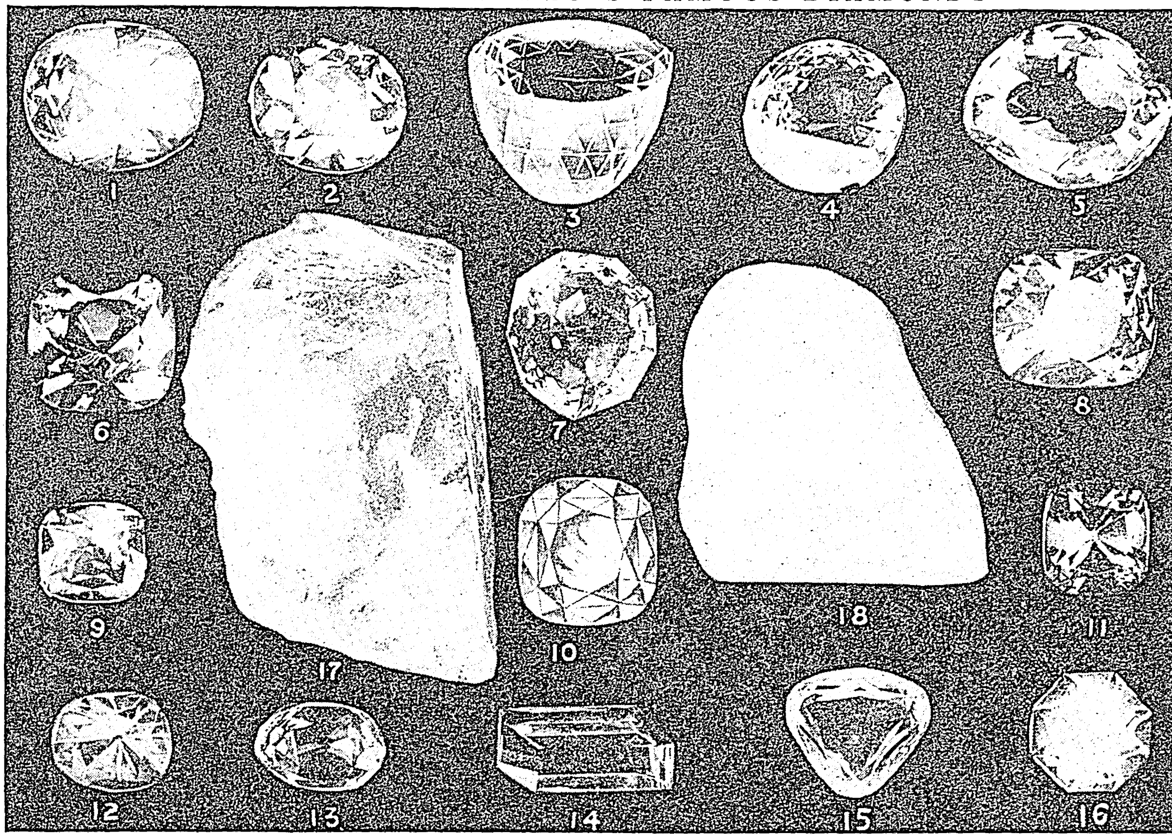


The lowest of these four sketches shows the shape of the famous Kohinoor diamond as it was first cut, following the old style. The other pictures show how it was trimmed into its modern form. This seems like a dreadful waste of precious material, but don't you see how, with those broader facets, it must flash back the light much more brilliantly?

The "Great Mogul" was the largest Indian cut diamond of which there is any record. It weighed 817 carats in the rough, but was reduced to 287½ carats by the unskilled cutting of a Venetian lapidary. It was seen by the French gem-dealer Tavernier in Delhi, in 1666, and is believed to have later formed part of Nadir Shah's booty. There has been no definite notice of it since Tavernier's time, so this great diamond must either have been lost or cut up into smaller stones.

The "Orlof" was one of the Russian crown jewels. One of the many strange tales that have been told of it is that it formed one of the eyes of an idol in a Hindu temple, and was stolen by a French grenadier. After passing through many hands, it came into the possession of an Armenian merchant, who sold it for $560,000 and a patent of nobility to Count

SOME OF THE WORLD'S FAMOUS DIAMONDS



If you had just one of the precious stones here shown, you wouldn't need to worry about money, for it would make you independent for life. They are: the Kohinoor after its second cutting, 106 carats (1), after first cutting, 186 carats (5); Loterie d'Angleterre (2); Great Mogul, 287½ carats (3); Orlof, 199¾ carats (4); Regent, 140 carats (6); Duc de Toscane (7); Star of South, 125 carats (8); Polar Star, 40 carats (9); Tiffany, after cutting, 125½ carats (10), before cutting, 287½ carats (18); Blue Diamond d'Angleterre (11); Sancy, 53¾ carats (12); Empress Eugenie, 51 carats (13); Sch[illegible] (14); Nassak (15); Pasha, 40 carats (16); Great Premier, before cutting (17).

Orlof, who gave it to the Czarina Catharine II. It weighs 199.73 carats.

One of the most celebrated diamonds in the world is the "Regent" or "Pitt" diamond. It is considered matchless in brilliancy and proportion. The rough diamond, as it was found in India, weighed 422 carats, but the cutting reduced it to 140 carats. One story is that it was stolen by a slave in the diamond mines who escaped to the coast and sold it to a shipowner for $26,000 and a passage to England. It was purchased by Pitt, governor of Madras, and later sold to the Duke of Orleans, regent of France, and became part of the crown jewels of France.

The "Jacobus Jonker" diamond was found in the Transvaal in 1934 by a prospector, after whom the stone was named. It weighed 726 carats in the rough. A New York dealer paid $750,000 for it.

"The Star of the South" is a great diamond found in 1853 in Brazil by a poor negress. It weighed in the rough 257½ carats. It is of great beauty and rose tinted.

But all other diamonds were outrivaled by the great Cullinan crystal which was found in the Premier mine in the Transvaal in 1905. It weighed in the rough 3,106 carats (1⅓ lbs.) and was about the size of a man's fist. It was presented to King Edward VII by the Union of South Africa, and the following year was cut into nine large stones and a number of small brilliants. The largest, "The Star of South Africa," outranks all other brilliants, weighing 530 carats. It is flawless and of great beauty. The "Lesser Star of South Africa" is second among the world's diamonds, and weighs 317 carats.

DIANA. A Roman divinity who was later identified with the Greek goddess Artemis. She was represented as the twin sister of Apollo, and was the moon-goddess as Apollo was the sun-god. Many stories show her also as a chaste huntress. (*See* Artemis.)

DIAPHRAGM (*dī'ȧ-frăm*). Next to the heart, the diaphragm is perhaps the most important muscle in the body. It is a dome-shaped membrane, extending across the body below the chest cavity and separating the lungs and heart from the abdomen. Its edge follows the general outlines of the lower ribs, being fastened to the breastbone in front. When the diaphragm straightens out and compresses downward, it sucks air into the lungs. It is thus the principal muscle of respiration. The muscles between the ribs are also used as respiratory muscles (*see* Respiration).

What is called "diaphragm breathing"—that is, using the diaphragm almost entirely and leaving the upper ribs of the chest extended in a stationary position—is used by singers in obtaining great volume and control of the voice. For ordinary purposes both rib and diaphragm breathing should be cultivated. Anything which restricts breathing, such as tight clothing or lacing, should be avoided.

DIATOMS. The tiny one-celled plants called diatoms are found by the billions of billions in all the waters on the face of the earth. The largest of them are barely visible to the naked eye and the smallest are less than a thousandth of an inch long. Yet each of them builds for itself a stone shelter as hard as granite, adorned with patterns of intricate beauty. More than 10,000 species are known, with many shapes—circular, square, boat-shaped, stick-shaped, and triangular.

Greatly enlarged photographs of diatom shelters (called *frustules*) appear with the article on Microscope. Each of them consists of two shells or valves, one fitting over the other like the top and bottom of a box, and held together along the edges by a girdle. Inside lies the living plant, resembling its relatives, the brown algae, in color and structure (*see* Algae).

Most diatoms float helplessly in the water or fasten themselves with a sort of jelly to stones or larger water plants. A few are able to swim slowly from place to place, but how they propel themselves is not clearly understood.

Diatoms usually reproduce by splitting in two. The interior living cell divides, the valves separate, and each half grows a new valve on its exposed surface. At times, two diatoms unite after shedding their old valves entirely, then divide into two larger individuals again, each of which forms two new valves. Some species reproduce by means of spores. In a few days, a single diatom may multiply into several millions.

In cold waters, where diatoms are most plentiful, the dead and the discarded shells may form thick deposits on the bottom. These shells, made of silica, the same mineral as quartz (*see* Silicon), are much harder and more durable than the chalky shells of mollusks. Thus, after long ages, the shell deposits turn into a porous mineral mass called diatomite (also known as diatomaceous earth, tripolite, and kieselguhr), composed of about 50 million shells to the cubic inch. On the sites of many ancient oceans and lakes, deposits of diatomite are found, some of them several hundred feet thick.

Diatomite is used as a chemical filter, particularly in the sugar industry; also in the preparation of heat-insulating materials, polishing compounds, and for mixing with concrete. (*See also* Ocean.)

DIAZ (*dē′äs*), **BARTHOLOMEW** (?–1500). The winds and waves that lash the stormy Cape of Good Hope drove Bartholomew Diaz, courageous Portuguese ship's captain and explorer, onward to fame and later caused his death.

As a youth, Diaz entered the dangerous gold and ivory trade along the African Gold Coast, and rose to the rank of captain. At this time Portugal, like other European nations, was eager for a share of the trade with India and the Far East on which the Italian cities were growing rich. The Italians, however, controlled the Mediterranean, the chief trade route to the East (*see* Commerce). And so the Portuguese dreamed of finding an all-water route around Africa—a hazardous venture for the little vessels of the 15th century.

When Diogo Cam (or Cão), a Portuguese explorer, returned home in 1482 with word that he had sailed past the mouth of the Congo River, the Portuguese king John II was encouraged to send out an expedition that would try to sail on around Africa and find the route to India. He chose Diaz to head the venture.

Diaz with three small ships left Lisbon in the summer of 1487. He sailed down the west coast of Africa and easily passed the farthest point any European had reached. About New Year's Day, 1488, a gale hit his cockleshell ships and for 13 days blew them southward, past the southernmost tip of land. Finally he managed to turn east but found no sheltering shore. Turning north, he sighted the coast of Africa, beyond the Cape of Good Hope. Unwittingly and out of sight of land, he had rounded the stormy cape.

The explorer sailed up the east coast until his crew, growing afraid, forced him to turn about. On the way back he mapped the southern waters, and in May 1488 saw for the first time the cliffs of the Cape of Good Hope (*see* Cape of Good Hope).

Diaz was joyously welcomed home about December 1488. Christopher Columbus, it is believed, was present when Diaz told the king about his journey.

The task which Diaz began was completed ten years later by Vasco da Gama, who sailed round the Cape of Good Hope and on to India (*see* Gama, Vasco da). Later Diaz himself set off again along the same route in an expedition headed by Pedro Cabral. Again the ships were seized by winds and currents, and were driven far out of their course to the coast of Brazil. Thus, if Columbus had not discovered America, it would have been discovered accidentally in 1500. Cabral's expedition sailed from Brazil to India, but Diaz' ship was wrecked and he perished near the stormy cape which he had discovered.

DIAZ (*dē′äs*), **PORFIRIO** (1830–1915). The boldly ambitious soldier-statesman, Porfirio Diaz, built Mexico from a weak and scorned nation into the promising country it is today.

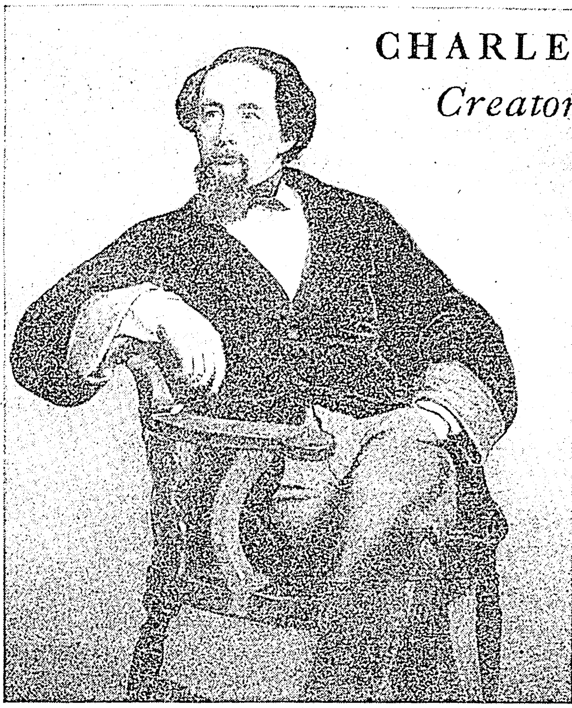
Diaz was born at Oaxaca, of mixed Spanish and Indian blood. His parents were poor. Determined to better his position, Diaz studied for the church and later read law. At 17 he interrupted his studies to serve in the war against the United States. After passing his law examination in 1853, he entered politics.

At that time Mexico was torn by civil wars, with numerous armed forces struggling for power. Diaz seized the advantage afforded by the national unrest. With ruthless daring he led revolts against the government, until, in 1877, he won the presidency of Mexico. He was reëlected in 1884 and, by special law, served continuously until 1911.

His dictatorial rule earned him the title of "Iron Man of Mexico." His entire régime was devoted to economic development of his backward country and, in his 30 years of power, he achieved tremendous results (*see* Mexico). But his disregard of the social needs of Mexico aroused public resentment, and in 1911 a revolt forced him into exile in Europe.

CHARLES DICKENS

Creator of Immortal CHARACTERS



Dickens was small, energetic, with clear blue eyes. He dressed in bright colors, and after he was 40 wore a mustache and "door-knocker" beard. This portrait of him was painted by W. P. Frith in 1859.

DICKENS, CHARLES (1812–1870). On a morning of 1841 a crowd of people are assembled on a pier of New York harbor. They are eagerly awaiting the arrival of a tall sailing ship, just in from England, and being towed to the pierhead. There is no ocean cable and she brings the latest news. What are they shouting, as soon as voices can reach?

"Is Little Nell dead?"

Little Nell is the child heroine in a serial story called 'Old Curiosity Shop', of which the latest issue is on the ship. And so eager are the people to learn how the story comes out that they cannot wait until the ship docks.

The author who could stir people to such excitement was Charles Dickens, then a young man of 29. Five years before, with his 'Pickwick Papers', he had leaped into celebrity such as had never before fallen to a writer. And the following year, 1842, on his visit to America, he was to receive a national reception second only to that of Lafayette in 1824.

Dickens' Life in Brief

Here is his life in brief: Charles John Huffam Dickens, born at Portsea (now a part of Portsmouth), Feb. 7, 1812; early youth in Chatham (1816–21); after that, London for the rest of his life, apart from travels and a country residence at Gad's Hill; reared in poverty; little school, no college; worked at the age of 10 at a menial job, later as a clerk in a law office; taught himself shorthand and got a position as a reporter in the House of Commons' Gallery (1831). As a reporter Dickens began writing sketches signed "Boz"; they met a ready reception. They were followed (1836–37) by the 'Pickwick Papers', a phenomenal success unparalleled in literature; Dickens threw himself into literature; stories fairly flowed from his pen—'Oliver Twist' (1838); 'Nicholas Nickleby' (1839); 'Old Curiosity Shop' (1841); 'Barnaby Rudge' (1841). He married Catherine Hogarth in 1836. He received in America a triumphant welcome (January-June 1842); traveled in France and Italy; combined novel writing ('Martin Chuzzlewit', 1844; 'The Cricket on the Hearth', 1845; 'Dombey and Son', 1848; 'David Copperfield', 1850; 'Bleak House', 1853) with editing a weekly magazine, *Household Words* (1850). Dickens floated on a flood tide of success which never ebbed. Taking the platform (1858), he had a success as a lecturer never equaled except perhaps by Mark Twain. Dickens' success never waned, but clouds darkened his private life; he separated from his wife; from domestic trouble he sought solace in work. His books continued: 'A Tale of Two Cities' (1859); 'Great Expectations' (1861); 'Our Mutual Friend' (1865). With books, lectures (1859, 1861–62, 1866), and editing, he worked to the verge of exhaustion. The strain was breaking him. A second lecture tour in America (1867–68) was overwhelming in success, but terrific in fatigue. Returning to England, he staggered on, refusing to stop. Suddenly, on the evening of June 8, 1870, he fell under a stroke, and, without speaking, died the next morning. He was buried in Westminster Abbey.

Childhood of Dickens

As a child Charles Dickens enjoyed whatever advantages go with early adversity. His father, John Dickens, was a small clerk in the Navy offices, an impoverished but genial man, blessed with an abundant family (Charles was number two in eight), but with little means. The close of the war between England and France (1815) lost him his position, and he drifted from one poor home in London to another, each lower in shabbiness than the last. Presently he drifted into the Marshalsea Prison for debt, and gathered in his wife and younger children with him. Here in alternate tears and merriment he lived the squalid life of a prisoner for debt which his son was later to depict in the imprisonment of Mr. Pickwick, in mingled light and shade, and the more somber experiences of Mr. Dombey under the shadow of the Marshalsea wall. Meantime little Charles, in tears and drudgery, worked in a tumble-down blacking warehouse, lived in a garret, visited his family in prison on Sundays, and felt his life shattered before it had begun. For the account of it see 'David Copperfield', whose early troubles are those of his creator. Then something "turned up" to liberate Dickens senior. A timely legacy restored the family to something like gentility, and little Charles had three or four years of quiet life at a private school.

Later he immortalized his father, for whom he always had a great love, as Mr. Micawber; and when his own rising fortune and celebrity gave him control of a great newspaper, he put his father on the staff to preside with great majesty over the foreign dispatches, bought him a little country house, and so allowed the good old gentleman a St. Martin's summer of sunshine after his harassed life. Dickens' mother, unsympathetic and unconscious of his genius, meant less to

him; she grudged his leaving work to go to school. Her, too, he made immortal as Mrs. Nickleby, a picture of the "eternal feminine" unsurpassed.

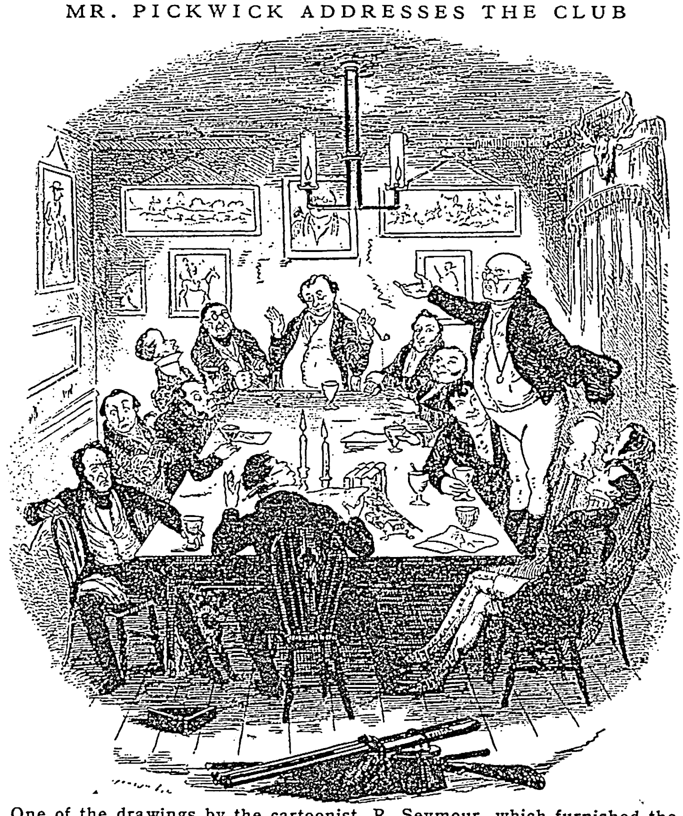
His Education Was Scanty

Dickens made his own career. A few years of secondary school constituted his education. College he never had. His education came from his reading and observation and rude experience. In a sense, Charles Dickens never was an educated man. He knew but little of what we call the great literature of the past. Of history he knew practically nothing. His novels all deal with his own day, except his two historical novels —'A Tale of Two Cities' and 'Barnaby Rudge'— and these were set in the times of the French Revolution and the Gordon Riots, which were living memories to his elder contemporaries. Of foreign politics he knew little, nor did he care. Foreign countries always seemed to him delightfully queer places where people wore amusing costumes and made comical attempts to speak English. To his self-satisfied Victorian mind their perpetual revolutions and conspiracies seemed absurd, when all they needed to do was to copy England. In France, where he spent much time and which he loved, he speaks with amusement of queer stuffy old men, shambling around in genteel poverty with dirty bits of red ribbon in their buttonholes. He had no eyes to see in them the wreckage of Napoleon's army, nor to realize that these same old men had seen the sunrise of Austerlitz, or had struggled through the snows of Russia. So, too, with philosophy and religion; Dickens' mind was entirely commonplace in regard to both.

By teaching himself shorthand Dickens secured the position of court reporter in the old Doctors' Commons, a quaint Elizabethan survival where they handled marriage, divorce, wills, and other "ghostly" causes. This experience gave Dickens the peculiar contempt for law which never left him; forever after it seemed either comic, as in "Bardell vs. Pickwick," or terrible with tragedy as in 'Bleak House'. Dickens moved up in 1831 to the Reporters' Gallery of the "old—the unburned and unreformed—House of Commons," and he also went out reporting election speeches, transcribing his notes "on the palm of his hand by the light of a dark lantern in a post-chaise and four." This experience got him forever a contempt for government as well as for law. To him the voters were represented by the Eatanswill Election in 'Pickwick', the parliamentary government by Doodle and Foodle and Coodle ('Our Mutual Friend'), and the Civil Service by the Circumlocution Office ('Dombey and Son').

Thus equipped, young Charles Dickens set out to conquer the world. The stage was his first dream. Night after night for two or three years he sat entranced with the melodrama of the cheap London theaters, lurid with love, battle, treachery, and blue fire, in which a heroic jack-tar would knock over 16 smugglers like ninepins. Melodrama put a stamp on Dickens for life. His characters, if they get excited, drop into the ranting language of the old Adelphi Theater. But, on the other hand, Dickens' intense concentration on acting helped to give him that weird power, almost mesmerism, that he showed in the public reading of his works.

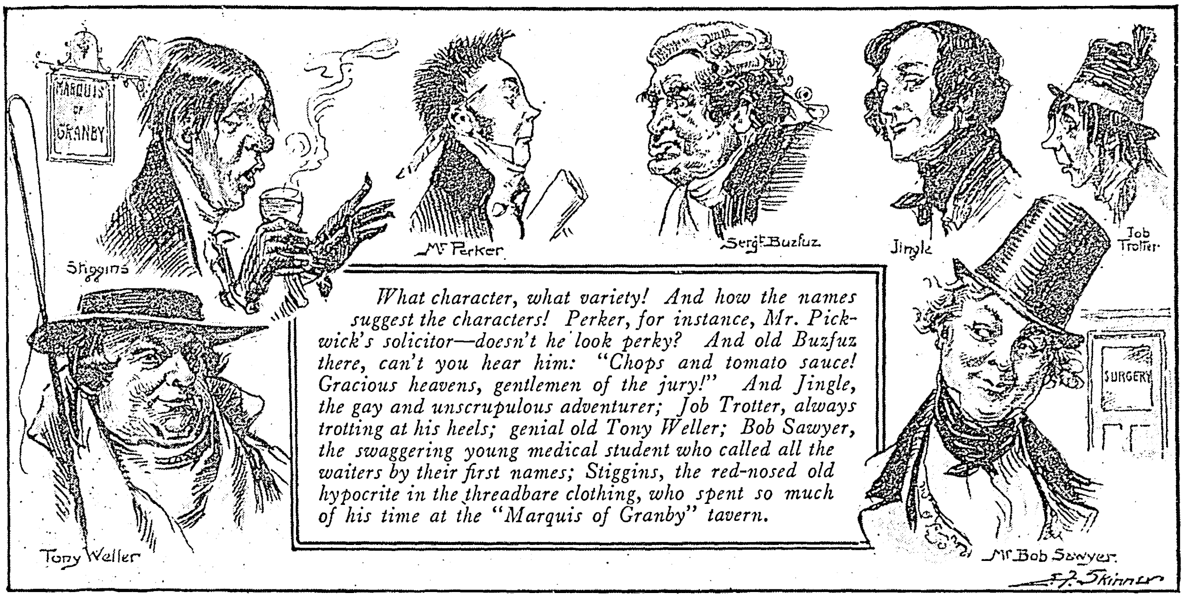
MR. PICKWICK ADDRESSES THE CLUB



One of the drawings by the cartoonist, R. Seymour, which furnished the inspiration out of which grew the immortal 'Pickwick Papers'.

'Pickwick' and Fame

But fate led him elsewhere. He had a passion also for writing, and he has told of his throbbing joy, of his eyes dim with tears when a manuscript sent anonymously to an editor appeared in all the majesty of print. So he began writing sketches under the name of "Boz," the family nickname of a younger brother. To "Boz" came a success so sudden that it literally staggered humanity. The publishers, Chapman and Hall, had a plan for some serial pictures of cockney sportsmen, a Nimrod club, having all sorts of misadventures. The humor of the day turned very much on such discomfitures. It just hatched out of horseplay. An artist called Seymour had drawn one or two pictures. They asked young "Boz" to write a set of stories to go with the pictures. Knowing nothing of sport, Dickens suggested turning the Nimrod club from sport to travel. When the publishers acquiesced, then, says Dickens.



What character, what variety! And how the names suggest the characters! Perker, for instance, Mr. Pickwick's solicitor—doesn't he look perky? And old Buzfuz there, can't you hear him: "Chops and tomato sauce! Gracious heavens, gentlemen of the jury!" And Jingle, the gay and unscrupulous adventurer; Job Trotter, always trotting at his heels; genial old Tony Weller; Bob Sawyer, the swaggering young medical student who called all the waiters by their first names; Stiggins, the red-nosed old hypocrite in the threadbare clothing, who spent so much of his time at the "Marquis of Granby" tavern.

"I thought of Mr. Pickwick," which is all that anyone has ever known, even Dickens, of the origin and genesis of the greatest character in the world's humor. The young author was to receive 15 guineas (about $75) for each monthly instalment, a rising fortune that lifted him to rapture, and at the same time to matrimony.

The very week that the 'Pickwick Papers' began their monthly appearance (April 1836), Dickens married Catherine Hogarth, one of the three pretty daughters of a newspaper associate. The young couple moved into rooms in Furnival's Inn, in a glow of pride and a whirl of importance, to have a home and a hearth of their own. Little did they realize that the ashes were one day to burn cold and dead. For it was, at the start, a love match. Dickens looked on Catherine, beautiful and silent, and saw nothing but the reflection of himself and did not realize the emptiness of the mirror; Catherine looked back adoringly at Charles, and did not realize that genius and egotism always lie close together. Dickens indeed was not so much in love with Catherine as in love with love.

With the marriage came the phenomenon of 'Pickwick'. At first the 'Papers' failed to sell—a few hundred copies only. Then into the book stepped Mr. Sam Weller, polishing boots at the White Hart Inn, and away went the narrative, on the wings of imagination, down English lanes, past gabled inns, and along the highways as varied and as cheery as a flying coach at a gallop—and the world was at the author's feet. The 'Pickwick Papers' and the books that followed without pause lifted young "Boz" to the height of success, from poverty to affluence, from nonentity to fame, all in a few brief years.

America Welcomes Dickens

Dickens now looked round for other worlds to conquer. America had welcomed his books from the start, all the more cheerfully since the lack of international copyright permitted anyone and everyone to print them without paying him. Dickens, in his youth a radical, hating Toryism and aristocracy, longed to participate in the new freedom. Leaving his four children at home, he landed in Boston with his wife in January 1842. The town blazed with excitement; society was thrilled; there were dinners, receptions, adulation. Young Dickens, dressed in all the colors of the rainbow, reveled in his new sovereignty, writing home of the freedom of America and the comforts of the workers. Longfellow, Channing, the élite joined in the welcome. Young Dr. Oliver Wendell Holmes was one of those who helped to organize it. Dickens found in Boston friendships which he never lost, even when bitterness and disillusionments altered his America. From Boston he went to New York, with a "Boz" ball of 3,000 people; to Philadelphia, with a huge public reception; thence to Baltimore and to Washington, where he met President Tyler and the Congress; thence to Richmond, which showed him what Southern culture could add to the more boisterous welcome of the North. Such was the triumphant progress of the young author, only a few years before in the shabby-genteel class of London.

Dickens Spurns America

But Dickens went no further. His disillusionment had begun. This was not the America of his dreams; for proof of it read his 'American Notes', his letters to friends, and his 'Martin Chuzzlewit'. The Americans all seemed to chew tobacco; he lived in a flood of it; they kept slaves, whom he never stopped to compare with factory slaves of England, from whom went up unheeded "the cry of the children." American government seemed all plunder and roguery; he forgot the sins of Coodle and Doodle and the swilling and eating of Eatanswill. Then he went West, traveling as far as Cairo, Ill. The West finished him; it seemed nothing but foul and reeking canal boats,

swamps, bullfrogs, and tobacco juice, ending in the pestilential morass called the Mississippi. Dickens had no eye to see the pageant of America, the great epic of the settlements of the West; no eye to compare the commodious canal boat with the raft and the scow of earlier settlers. He turned into a peevish cockney snob, impatient of every small discomfort, resenting the fact that hotelkeepers should dare to talk to him. He turned his back in disgust, venting his spleen on the grievances of copyright, the theft of his books, without a thank-you for the national tribute of his reception. He spent two weeks in Canada, consoled there by the presence of the real nobility and the English garrison in Montreal, and so home to turn and rend America with his pen. The odd thing is that the Americans, after a little swearing at him, soon forgave him.

Fame and Fortune

The years that followed Dickens' return from America, the middle period of his life, were filled with activity, fame, and success. He took a fine residence at Tavistock Square (1851), and lived in style, though he never entered high society, preferring to be a bigger toad in a smaller puddle. The give-and-take of social intercourse was beyond or beneath the egotism of his genius. Later on, his purchase of a country house at Gad's Hill fulfilled an ambition of his childhood. His books, appearing in monthly serial parts, enjoyed a popularity that slackened only to rise again. It is generally thought that 'David Copperfield', written as a serial in 1848 and 1849, when he was at the height of his powers, is the greatest of his novels. The 'Pickwick Papers', being scarcely a novel, stands on other ground. The two books show the transition of Dickens' genius from the exuberant merriment of youth to the riper mind of middle age. There is less echo of laughter, and more tears fall upon the page.

One book at least, 'Dombey and Son', is a sort of epic of sorrow. Dickens' books indeed appealed to his generation as much for their tears as for their laughter. The Victorians ran easily to sentiment. They liked to cry, just as we like to laugh.

Impetuous Journalist and Actor

With book writing went newspaper editing. Dickens felt the need of reforming all the world, beginning with England. The way to do it, he felt, was to control and edit a great daily newspaper, where he should preside like Jupiter handing out lightning. No Pecksniff that Dickens ever described was more conscious of his own morality. Enthusiastic friends subscribed £100,000 and founded the *Daily News*. Dickens threw himself eagerly into the editorial chair (January 1846) and threw himself out again in 19 days. He found that in the newspaper business the lightning hits both ways. So he founded instead a weekly journal, *Household Words*, and carried on with it and a later magazine, *All the Year Round* (1859), till his death. Several of his own stories, 'Christmas Stories', 'A Tale of Two Cities', 'Great Expectations', and others, ran in his magazine. All contributions were unsigned and all edited, altered, and revamped by Dickens who slaved away with scissors and paste, like a race horse on a treadmill.

Another activity, and this a delight, was amateur theatricals, that carried on Dickens' early love of the stage. He himself had incomparable power, if not of acting, at least of something even higher, and with it a great talent for management and an energy and enthusiasm that carried all before it. Once (May 16, 1851) at a performance given at the Duke of Devonshire's London house for a charity, the young Queen Victoria and her Prince Consort and the Duke of Wellington were in the audience. The Queen came to a later performance (1857) and graciously "commanded Mr. Dickens' presence" after the show. Mr. Dickens being in "farce" dress ungraciously refused to go, thus defying all precedents.

Dickens as a Lecturer

To theatricals presently was added public lecturing, or rather public readings from his works, that originated in his reading one of his famous Christmas stories to a group of friends. The result was a succession of tours in England, Scotland, and Ireland (1858–59, 1861–63, 1866–67, 1869–70). Dickens developed a phenomenal power on the platform. He read not only lighter scenes, as the trial in 'Pickwick', but scenes of tragedy, the storm at sea in 'Copperfield', and pathos, the death of little Paul Dombey. The effect was mesmeric. Something seemed to go out from him and clutch the audience. Again and again people were carried out fainting, or sat immobile, frozen with horror, or roared and rocked in uncontrollable laughter at the lighter pieces. But the strain on the man himself was terrific.

Dickens Leaves His Wife

All this time the shadows were gathering over a life outwardly resplendent. The fire on the hearth had died in Dickens' home; for years intimate friends had known that he and his wife no longer seemed compatible. Presently the world learned, in a public notice sent forth by Dickens, that the husband and wife had agreed to part. When the world insisted on asking questions, Dickens was furious; he expected to enjoy at the same time the luxury of fame and the seclusion of obscurity. His friends maintained, even after his death, a conspiracy of silence; the matter still remains a mystery.

There is no doubt that Georgina Hogarth, the wife's younger sister, who had lived with them since 1842, had taken away Catherine's place as companion and confidant. She remained with Dickens after the separation till his death; he left her a large part of his fortune. He had made his wife an allowance of \$3,000 a year out of an income of almost \$150,000.

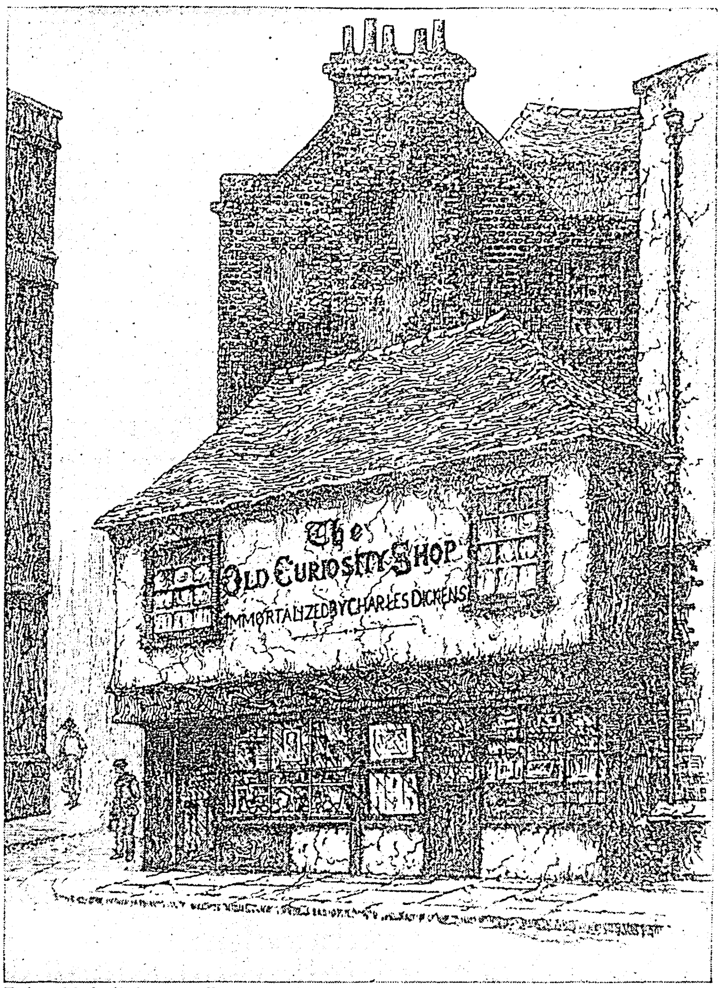
Working to Death

After his separation from his wife, Dickens sought relief in the strain and excitement of work. His large family (there were seven boys and three girls to be provided for), his heavy expenses, and his recollections of early poverty gave him a sort of delusion of indi-

gence even in prosperity. He eagerly embraced the opportunity of a second American tour and carried it out (1867–68) with heroic resolution in spite of fatigue that was almost fatal. This time he avoided all public receptions and even private hospitality. It was the America of the close of the Civil War, throbbing with new interests, yet warm with heroic memories. Dickens, worn to death, had neither eyes nor ears for it. At home again, he resumed the strain of lecturing (1869–70). For new sensations he worked up as a reading (from 'Oliver Twist') the killing of Nancy by Bill Sikes, till his audience shivered with horror. But he was paying the price with his life. His sight at times failed. On the street, he could see only half of the letters on the signs; words slipped from him; his touch failed and his hands groped, feeling in the air. Retirement from the platform for the moment saved him. At a last appearance (March 1870) he said to a London audience, "From these garish lights I vanish forevermore," and over the great hall there passed a sigh like the rustle of dead oak leaves in autumn.

In retirement he struggled with his last task, 'The Mystery of Edwin Drood', a tale of night and storm and murder. He guarded jealously the secret of the plot—all too jealously, for it died with him. The book was still unfinished on the evening in 1870 when Dickens sank stricken to the floor.

A DICKENS LANDMARK IN LONDON



This old building on Portugal Street, Lincoln's Inn Fields, London, is said to be the original of the Old Curiosity Shop which Dickens described as the home of Little Nell and her grandfather.

The Magic of Dickens

Academic teachers have not yet learned to place Charles Dickens where he belongs—in the opinion of many—as England's greatest creative writer. His humor is unsurpassable, not only in the merry laughter that lies like sunlight on the surface, but in the warmth of human kindliness below. It is a sort of magic that can somehow shed a charm over a scamp like Alfred Jingle, and lend amusement to a damp horror like Mrs. Gamp, or a brute like Wackford Squeers. It is a transformed world, a magic garden in which somehow even the worst of beings appears as he might have been rather than as he is.

In the hundred years that have passed since 'Pickwick' appeared, people have been reading Dickens all over the world—in idle moments of happiness, in hours of loneliness, in the anxious vigils of the sick room, and in the long years of exile in distant lands—and finding always a temporary surcease of pain, a temporary oblivion of sorrow.

Books About Dickens

The standard work on Dickens is 'The Life of Charles Dickens', written by his great personal friend John Forster, which first appeared in three volumes (1872–74). Other first-hand authorities are 'Letters of Charles Dickens', collected by his daughter, Mary (Mamie) Dickens; a book by her entitled 'My Father As I Recall Him', and 'Memoirs of My Father', by his son, Sir Henry Fielding Dickens.

Of critics and criticism, chief importance is to be attached to the writings of the late G. K. Chesterton—'Charles Dickens' (1906), and a series of 'Appreciations and Criticisms of the Work of Charles Dickens' (1911). Other studies are 'Charles Dickens: A Critical Study', by George Gissing; and 'With Dickens in America', by W. G. Wilkins. Recent studies are Stephen Leacock's 'Charles Dickens: His Life and Work' (1934); Thomas Wright's 'Life of Charles Dickens' (1936), and M. L. Becker's 'Introducing Charles Dickens' (1940). French points of view appear in Taine's study of Dickens in his 'Histoire de la Littérature Anglaise' and P. Delattre's 'Dickens et la France'.

On Dickens' England there are F. G. Kitton's 'The Dickens Country' and W. Dexter's 'The London of Dickens', 'The Kent of Dickens', and 'The England of Dickens'.

DIC'TAPHONE. An instrument called the dictaphone is used in many business houses to lighten the task of dictating and transcribing letters. It consists of two separate mechanisms—one, called the dictating machine, to record spoken words; the other, called the

transcribing machine, to reproduce them. Both work on the principle of the phonograph (*see* Phonograph).

Dictation is directed into the mouthpiece of the dictating machine and recorded phonographically on a wax cylinder. From this record the transcribing machine reproduces the dictation so that the typist hears it through earphones and can transcribe it on the typewriter. A cylinder may be used over and over again by shaving off the old surface.

Outside the business world, the dictaphone has many interesting uses. Authors dictate their stories or notes into it before the ideas have time to escape. Actors polish their lines for a play by speaking into the dictaphone and then listening to its reproduction of their voices. Language experts take the dictaphone with them on travels to record languages and dialects. Some scientists use the dictaphone instead of pencil and paper to record observations in laboratory and X-ray room.

DICTATORSHIP. This term as understood today means a form of government in which the will of one man, the dictator, is law, and in which no legal power to remove him exists. Any energetic chief executive tends to extend his powers unless restrained by other authorities, but until leadership becomes so strong that it can block all opposition it cannot be classed as dictatorship.

Dictators Among the Ancients

History has always provided dictatorships. The early Pharaohs were dictators in Egypt. In ancient Greece the "tyrants" resembled modern dictators. They commonly arose when a group of powerful citizens became arrogant and refused to share power with outsiders. A self-appointed leader would arouse the people with promises to remedy their grievances, and would then overthrow the existing group and govern in the name of his supporters. Some of these men, such as Periander in Corinth and Pisistratus in Athens, governed very ably. Seldom, however, did such men live out their days in peace. Some failed to remove all their enemies, or in doing so frightened or sickened their own supporters. Others lost influence as the glamor of their personalities wore off and the people sought a change.

Dictatorship Under Roman Law

In the Roman republic the law provided for a dictatorship when the republic was in danger of invasion, civil war, or political deadlock. All power was centered in the hands of one man while the crisis lasted, but he had to lay it down within six months and account for his acts. Cincinnatus was such a dictator (*see* Cincinnatus). Later Sulla and Julius Caesar took and held power by force, and the legal dictatorship was abolished. The Roman dictators who followed used the title of emperor. They often gained power through civil war, being set up or dethroned at the pleasure of the Praetorian Guard, the soldiers who formed the imperial guard in Rome.

During the Middle Ages there were no dictators in Europe, unless we choose to call Charlemagne a dictator. The early kings of France and England had to govern according to "customary law" and the great nobles always resisted any extension of the royal power, so there was little opportunity for the kings to set themselves up as dictators. Even Louis XIV, the "grand monarch" who is supposed to have said "I am the state," was restrained by numerous curbs upon the arbitrary exercise of his power.

Some Later Dictators

In the 17th century, England, to escape from civil war, submitted to a dictatorship. Cromwell, her "strong man," purged Parliament of all opposition and governed for eight years, passing his power to his son Richard, who was unable to hold it.

France had two dictatorships in the 19th century. Napoleon I assumed power in several steps. First he roused the French to mad enthusiasm by his military victories, then held their government (the Directory) up to ridicule. He overthrew the Directory in 1799, had himself chosen first consul, then consul for life, and finally emperor, securing joyous ratification by a plebiscite. He was later defeated and exiled. His nephew Napoleon III set up a less successful dictatorship in 1852, but his empire was overthrown during the Franco-Prussian War, and he also was exiled.

Latin America has been largely governed by dictators. In many of these young republics the people did not understand self-government, and were easily carried away by ambitious leaders who were liberal with promises. Once in power these men disposed of their political opponents, suppressed all criticism, and governed ably or badly until overthrown.

Dictatorships After the First World War

The most interesting experiments in dictatorship are those which arose in Europe after the first World War. The war was fought, said President Wilson, "to make the world safe for democracy." Yet scarcely were the peace treaties signed when European countries began to forsake the principles of democracy and set up dictatorships. This was true not only of a number of the new nations that grew out of the war, but of some of the old long-established nations, such as Russia, Italy, and Germany. And among them were nations that had only recently freed themselves from despotic rule. Why did peoples who had suffered at the hands of czars and emperors turn to a form of government that deprived them of many of the privileges for which they had fought? Why did other peoples who had enjoyed the privileges of democratic government give up freedom of speech and of press, party debate on important questions, private regulation of industry, and many other rights that they had heretofore claimed?

The causes were different in different nations. In general, the way was paved for ambitious leaders by wartime exhaustion, weak governments, national bankruptcy, widespread unemployment, uncertain boundaries, and a host of other problems that needed immediate solution. Then, too, people had become accustomed during the war to being regimented, to

accepting the rule of a strong central authority, and to obedience in social and economic activities.

Conditions were particularly unstable in some of the new countries. They faced boundary disputes and difficulties created by racial minorities as well as by lack of political experience. And in most of them a leader appeared who was powerful enough to impose a dictatorship or a partial dictatorship.

In the little Baltic states—Lithuania, Latvia, and Esthonia—which had been freed from Russia after the war, tendencies toward communism were suppressed by dictatorial rule. In Yugoslavia, King Alexander I, seeing his new nation threatened by the contest between the Serbs and Croats, set himself up as dictator. In Poland, where one weak government followed another, Marshal Pilsudski in 1926 seized dictatorial powers, and set up a strong government on Fascist lines. In Austria, civil strife and foreign interference led Chancellor Dollfuss to dictatorship in 1934.

Postwar depression and unrest in Spain permitted Primo de Rivera to set up a military dictatorship in 1923. Revolt against the republican government led to a two-and-a-half-year civil war which brought Gen. Francisco Franco to power in 1939 as a Fascist dictator (*see* Franco, Francisco). In Portugal unsettled conditions led to the establishment of military rule in 1926, and in 1932 Antonio Salazar became the leading figure in a Fascist dictatorship.

The postwar years saw the rise of two strong dictatorships in the Middle East. In Turkey the able Mustapha Kemal Pasha transformed "the sick man of Europe," defeated and war-shorn, from a decadent empire into a modern progressive state. In backward, tradition-bound Persia, Reza Khan came forward to strengthen and modernize his country.

A discussion of the conditions that brought about all of these dictatorships and of what they have accomplished will be found in the articles on the countries involved.

Italy, Germany, and Russia

Almost all of the postwar dictatorships have been influenced to a greater or lesser degree by the Fascist methods of Italy's dictator, Mussolini. Fascism, therefore, has come to be considered as the typical dictatorial form of government in this era. Its principles are described in detail in the article Fascism. Hitler's Nazi dictatorship in Germany is built along Fascist lines, although in some respects it differs from that of Italy. (*See* Germany; Hitler, Adolf; Italy; Mussolini, Benito.)

The communist dictatorship of Russia is essentially different from that of Italy or Germany. Communist theory advocates what is called "dictatorship of the proletariat." This would place all political and economic power in the hands of the working classes, but it is opposed in principle to an individual "strong man" as dictator. Yet the leaders of the communist party in Russia—first Lenin, and later Stalin—established themselves as individual dictators to pave the way for working-class rule by a vigorous campaign of popular propaganda and industrial organization.

SOME MODERN DICTATORS AND THE DATES OF THEIR RISE

Mustapha Kemal
Turkey—1920

Benito Mussolini
Italy—1922

Joseph Stalin
Russia—1928

Antonio Salazar
Portugal—1932

Adolf Hitler
Germany—1933

In theory, then, the rule of the one-man dictatorship in Russia is only a temporary expedient. It is to end when opposition to communist principles has been wiped out (*see* Lenin, Nikolai; Russia; Stalin, Joseph). Fascism and Naziism, on the other hand, maintain that a centralized dictatorship is the only type of government capable of coping with the complex industrial conditions of today, and combining national unity with economic efficiency. A Fascist state, therefore, looks upon dictatorship as a permanent institution.

How the Dictator Gains His Power

The rising dictator of the postwar period sometimes has no program (Mussolini had none in 1922) but always makes promises to restore order at home and prestige abroad. He gains supporters by his vigor, his intolerance of delay, and his oratory. He makes his followers feel their part in renewing the greatness of the nation. He gains the support of powerful groups by promising them a place in the new order. He heaps discredit on the existing government, while creating an impression of the irresistible strength of his own followers by massing and parading them.

Once in power he must destroy all opposition while holding his popularity with the masses. Factions

opposing him do not stand together and can be wiped out piecemeal. All political power must then be centered in his hands, and his will replaces the old constitution and laws. Popularity with the multitudes is gained partly by flattery, partly by trading them economic security for their political liberty, by dazzling them with great public works, and by focusing their fears and hatreds on some group of "undesirable" citizens within (as Hitler did with the Jews and Stalin with the "bourgeois" and "capitalists"), or some possible enemy without.

Weaknesses of Dictatorships

Dictatorship often functions very well for limited periods. When political factions are blocking progress, or when rapid action is needed to meet emergencies, dictatorships will break deadlocks and get things done. If people have not had enough political experience to know how to govern themselves well, a dictatorial form may be needed while they learn. In time of war even well-established democracies allow the government dictatorial powers for its duration, in the manner of the ancient Romans.

But dictatorships have important weaknesses. A dictator may rule efficiently when young and alert, but with age he may become too weary to act decisively. He may become intolerant of advice, making serious blunders which a legislature might have checked. It is difficult to transfer power peacefully from one dictator to another; a strong successor would be a menace to his predecessor when alive, and a weak one could scarcely hold strong rivals in check after his predecessor's death. In Soviet Russia, Lenin left the choice to his followers. The triumph of Stalin came only after a long internal struggle and the exile or execution of many opponents. Most dictatorships have ended in revolution, assassination, or banishment. The exaltation by dictators of force and arbitrary will in place of law makes it difficult for them to bind their countrymen to use peaceful methods in choosing their successors.

DIC'TOGRAPH. This device, which works on the principle of the telephone, is used chiefly to communicate between business offices within a building. In each of the offices is a small box, containing a transmitter, or microphone, and a receiver, or loudspeaker. Contact is made with another dictograph user by flipping a key on the box. The person talking needs no mouthpiece, for the microphone is so sensitive that it can pick up a whisper several yards away. The person listening in another office needs no earphone, for the loudspeaker can be heard across a large room.

Another application of this device is the detective dictograph, used to trap criminals. This is essentially a sensitive microphone, hidden in the suspect's room. The words picked up by the microphone are conveyed by wires to a stenographer wearing earphones, and the notes so obtained may be used as evidence.

DIGESTION. If we want a steam engine to run and furnish power, we must feed it the proper fuel. If we fail to stoke it, keep it cleaned of waste, and repair worn out parts, the engine stops. The human body is a machine with the same needs; but it is far more efficient than the engine, and even makes its own repairs.

The animal engine, our body, works well only when we "stoke" it with proper food, for food is both fuel and repair material. It is digested, absorbed, and burned; and thus we get power, heat, and energy to do work. All the while chemical changes and activities are going on in our living cells, changes which build up and others which tear down. All these are summed up by the term *metabolism,* which means nothing more than "change." Constructive changes leading to the formation of new cells and tissues are called *anabolism.* Destructive changes resulting in the breaking down of protoplasm and other complex substances are called *catabolism.*

Proper metabolism is made possible only by digestion, which reduces foods to the simple and soluble state necessary for absorption into the body and utilization by the cells. Man has a special set of organs whose business it is to do this work and nothing else. These organs form the digestive tract. (*See* illustration under Physiology.)

How Foods Are Prepared for Use

The tissue cells or living units of which the human body is made require five classes of foods—proteins, carbohydrates, fats, mineral salts and water, and vitamins (*see* Food; Vitamins). There are two methods of preparing these foods for use by the individual tissue cells. One method is a mechanical one, like chewing; the other is chemical, like the changing of starch into sugar. This chemical action is accomplished by means of certain fluids found in each of the digestive organs. In the mouth this fluid is alkaline and is known as "saliva"; in the stomach it is acid and is called "gastric juice." Into the intestines are poured three distinct fluids—the "intestinal juice," the "bile," and the "pancreatic juice." The bile is made by the liver (*see* Liver). The pancreatic juice is made by the pancreas, a gland some seven inches long which lies behind and below the stomach (*see* Gland).

These digestive fluids have in them certain ferments called "enzymes," which may well be called "helpers" of digestion. Each digestive fluid has its own particular set of "helpers," usually two or more; and if these are absent from any cause whatever, the work of that fluid is seriously hindered if not stopped (*see* Enzymes).

In the mouth the saliva has two enzymes or "helpers"—"ptyalin" and "maltase"; these help to change the starch into sugar. In the gastric juice of the stomach the helpers are "pepsin" and "rennin," which act upon the proteins (eggs, meat, and the like) changing them into peptones. The pancreatic juice has several helpers—"amylopsin" (which finishes the digestion of starches), "trypsin" (which continues the work on proteins), and "steapsin" (which splits up the fats). These are the principal enzymes, but there are a dozen or more of these helpers in all. The enzymes never meddle with each other's work. For

example, the ptyalin and maltase of the saliva work very rapidly in changing the starch into sugar, but they pay no attention whatever to the meats or eggs. And the enzymes of the gastric juice act on the meats and eggs, while they ignore the starches.

Bearing in mind these two methods of preparation (the mechanical and the chemical), as well as the five great classes of foods, let us take an ordinary dinner of milk, fruit, meat, and vegetables, and follow it on its way to the tissue cells.

In the first place the food enters the mouth; here it is thoroughly masticated or crushed by the teeth (if we are not too lazy) and mixed with the saliva. The saliva softens the entire mass so that it may be tasted and swallowed; it also changes some of the starch in the bread and vegetables (potatoes, perhaps) into sugar. But this work it does not complete, because the food does not stay in the mouth long enough.

Chemistry and Machinery of the Food Factory

The entire softened mass is now passed on through the esophagus or "gullet" to the stomach. The mechanical process here is a peculiar one. The muscular walls enable the stomach to move this food mass with a churning movement known as the "peristaltic" motion. This again thoroughly mixes the food mass with the gastric juice which is secreted in the stomach. This juice is acid and contains both pepsin and rennin. The acid softens the connective tissue of the meat and the fibers of the vegetables, and prepares them for the action of the pepsin. The rennin acts upon a protein (casein) of milk, changing it to another protein called "curd." Then the pepsin changes proteins, including the curd, into peptones. The saliva continues its action on the starches, but soon stops because it cannot act in the presence of the acid. The fats are freed from connective tissue and float as little globules.

This food mass which now occupies the stomach has become a rather thick yellowish fluid, called "chyme." A small portion of the water and dissolved salts is taken up by the blood vessels of the stomach; but the bulk of the chyme passes on gradually into the intestines. Here the process of digestion is continued. The intestines are about 30 feet long and the mechanical movement is a continuation of that of the stomach. The intestinal fluid is a mixture of intestinal juice, pancreatic juice, and bile. Pancreatic juice (alkaline) finishes the work on proteins of meats and vegetables, which was begun in the stomach. It also finishes the change of starch into sugar. Fats are split up into fatty acids and glycerin. Soaps are made here and used to "emulsify" or divide the fats into small particles that may be absorbed by the lymphatic glands, or lacteals, in the intestine walls. Digested proteins and carbohydrates go directly into blood capillaries. The indigestible waste is carried into the large intestine and is eliminated there.

Thus we see that the proteins in our meat and vegetables were partly digested in the stomach and finished in the intestines; the sugar and starch in our fruit and potatoes were prepared in the mouth and intestines; the work on the fats is finished in the intestines. The salts and water need no digestion; and exactly how vitamins produce their results is still unknown.

This dinner, which was presented to us largely in solid form, has been transformed by the process of digestion into a liquid ready to be taken up by the blood vessels of the intestines. Much of it goes to the liver and may be stored there or changed. Eventually all simplified food is carried to the heart to be distributed all over the body by the arteries.

Control of Our Food Factory

These organs of digestion are largely under the control of nerves. For example, the mere thought of food will cause the juices to start to flow, and we all know the "dry mouth" of fear or anxiety. Also the thought of distasteful food tends to stop the flow of the gastric juice. The digestive organs really form a food factory—one which takes raw materials and converts them into materials for the cells which are to use them. When we overcrowd this factory the workmen are hampered or embarrassed, wastes of necessity accumulate, and the general quality of the food product goes down. When we introduce materials which the factory is not prepared to handle, similar results follow. If we would keep this factory running and in good shape, we must not work it overtime, nor irregularly; for it must have its periods of rest if it is to do good work. Let us then take very great care of this wonderful machinery; for once any part of it is broken or injured, its repair becomes a serious matter. (For a picture of the process of digestion *see* Physiology.)

DIOGENES (*dī-ŏg'ĕ-nēz*) (412–323 B.C.). Many anecdotes are told of this eccentric Greek philosopher. At one time, it is said, he was seen carrying a lantern through the streets of Athens in the daytime, and on being asked what he was looking for, answered, "I am seeking an honest man."

Diogenes came to Athens from the Greek colony of Sinope, on the Black Sea. He adopted the philosophy of the Cynics, who taught that to attain wisdom and virtue one must give up all the pleasures of life, which stand in the way of self-mastery. So he got rid of all his possessions, except a cloak and purse and a wooden bowl. He even threw away the bowl as unnecessary, when he saw a boy drinking from the hollow of his hand. It is said that he lived in a cask or tub, and in order to harden himself he used to roll in hot sand in summer, and in winter he embraced snow-covered statues.

At one time he made a voyage and was captured by pirates, who sold him as a slave in Crete. When asked his trade he replied that he knew no trade but that of governing men, and that he should be sold to a man who needed a master. He was sold to a master, who took him to Corinth to conduct the education of his children, and there he became famous.

Once Alexander the Great came to see him at Corinth and asked him if there was any favor he could do him. Diogenes replied that the only thing Alex-

ander could do for him was not to stand between him and the sun. Alexander was so struck with this answer that he said: "If I were not Alexander, I would be Diogenes." Diogenes died at Corinth, and a pillar was erected to his memory.

DIOGENES AND THAT LANTERN TRICK

The Greeks, famous for so many other things, were no more distinguished for honesty than other peoples of their time. In order to bring the matter home to them, Diogenes resorted to this little ruse of carrying a lantern in the daytime, so that they would ask him why, and he could reply that he was "looking for an honest man."

DIONYSUS (*dī-ō-nī'sŭs*). A beautiful youth, glowing with vigor and attired in radiant garments, was wandering alone on a sea-beach in Greece—so the old story tells us—when a band of pirates approached. Knowing that his beauty would command a good price in the slave markets of Asia, they seized the youth and carried him to their vessel. But scarcely was he on board when the fetters dropped from his limbs.

"We have tried to bind a god!" cried the pilot, as he beheld the miracle. "Let us hasten to restore this youth to the spot whence we took him, lest the immortals, for our impiety, afflict us with adverse winds and storms."

Heedless of these words, the pirates set sail for the open sea. But presently the ship stood still. Tendrils of ivy twined about the oars, the masts and sails were quickly covered with vines laden with ripening grapes. Strains of magic flutes were heard and streams of fragrant wine trickled over the vessel.

The terrified crew entreated the pilot to steer for the shore. But it was too late. The youth changed into a roaring lion, and rushing upon the captain tore him in pieces. The sailors maddened with terror leaped overboard and were changed into dolphins. Only the pious steersman escaped this fate. The captive, resuming his true form, revealed himself as the great Dionysus, the god of the vine and the growing principle of Nature, whom the Romans called Bacchus.

This is but one of the many adventures that befell Dionysus, during a time when he lived on earth and traveled from country to country, teaching men to cultivate the grape and to make wine. Often he rode in a chariot drawn by lions and leopards, and was attended by satyrs and bands of dancing women called Bacchantes. The satyrs were woodland deities, represented as half human, half goat—hairy creatures, with pointed ears, broad snub noses, and short tails, dancing on cloven hoofs to the weird music of their flutes. The Romans called them fauns.

Dionysus was the son of Zeus (Jupiter), the god of the sky, and of Semele, a goddess representing the earth. In his early years he was cared for by an aged satyr named Silenus, who remained one of his favorite companions. Dionysus was represented in works of art as a beautiful youth, crowned with vine leaves or ivy, and wearing a faun skin over his shoulders. His festivals were celebrated with processions, dances, and choruses, out of which grew the Greek drama and the Greek theater. In Rome the Bacchanalia, or festival of Bacchus, was celebrated every third year; but it became so immoral that in the year 186 B.C. the Roman Senate forbade its further observance. (*See* Drama.)

DIPLOMATIC SERVICE. The old joking definition of an ambassador was that he was a man "sent to *lie* abroad for his country." The joke consisted in the fact that you might take the word "lie" either in its then common meaning of "reside" or in the other and less honorable sense. Unfortunately, the older diplomacy, which was largely an unscrupulous battle of wits, only too often made the latter meaning the more fitting one.

But today the demand for more frank and open relations between nations has changed the standards of diplomatic conduct, and the value of the members of the diplomatic service of modern countries is no longer judged by their skill in international trickery.

Every great country appoints ambassadors or resident ministers to represent it at the capitals of other countries, and on occasion sends "ministers plenipotentiary" on special missions. Both ambassadors and ministers serve as the chief channels for official communication between the countries they represent. But only ambassadors are looked upon as the direct representatives of the head of the nation and as such have the right to personal audience with the sovereign or chief of the country to which they are accredited. In ceremonial gatherings they take precedence over all save heads of government.

Diplomats have been important officials since the time of the Byzantine Empire. At first ambassadors were sent only on special missions to the courts of the barbarians or to Rome. But these proved so valuable that Venice developed the practice of sending permanent representatives to neighboring states, and the custom soon became general. Today when the tele-

graph and wireless place the capitals of the world in almost instant communication, the task of diplomats is lighter and their authority far less than in former days.

In addition to ambassadors and ministers, who are appointed by the President, the diplomatic corps of the United States, like that of most other nations, includes secretaries of various grades who assist their chiefs in the routine work of office. These positions are under civil service, and vacancies at the bottom are filled by competitive examinations. In 1924 a Foreign Service School was established in the Department of State for the training and probation of newly appointed foreign service officers.

The United States Foreign Service, which is a part of the Department of State, includes a second branch, the consular. Consuls are commercial representatives, "a nation's lookouts on the watchtowers of international trade." They are stationed at all the important centers of commerce in the world and not only supervise exports to their own countries, and give advice and help to their countrymen abroad, but they also seek out commercial opportunities in foreign lands and report these to their home governments. In the United States, these reports are sent to the Department of Commerce and distributed to the commercial public in the department's weekly *Commerce Reports* or in special bulletins.

The division of diplomatic representatives into the four ranks—ambassadors, ministers plenipotentiary, ministers resident, and *chargés d'affaires*—was made by the Congress of Vienna in 1815. Until 1893 the United States withheld the rank and title of ambassador from its accredited representatives, but since that date it has sent ambassadors to capitals of note, especially where these foreign nations were represented by an ambassador at Washington. Diplomatic representatives are exempt from arrest for ordinary offenses committed in the country to which they are accredited, and their residences abroad, called embassies in the case of ambassadors, and legations in the case of ministers, are looked upon as part of the soil of their home countries.

DISRAELI (*dĭz-rā'lĭ*), BENJAMIN, EARL OF BEACONSFIELD (1804–1881). A clever novelist and a brilliant statesman were combined in Benjamin Disraeli, who became the great rival of Gladstone in the House of Commons, and twice held the position of prime minister of Great Britain. In his early years Disraeli was handicapped by the fact that, though a Christian himself, he was the son of Jewish parents; and he needlessly handicapped himself by his foppish dress—his perfumery, lace, jeweled satin shirt-front, profusion of expensive rings outside his gloves, green velvet trousers, and other extremes of fashion. His speech and manner were as affected as his dress, and the first time he tried to make a speech in the House of Commons he was ridiculed so that he had to give up the attempt. But before he did so he shouted, "I shall sit down now, but the time is coming when you will hear me."

Disraeli worked hard to make this prophecy come true. He studied the style of parliamentary speakers. He gave up many of his peculiarities of dress and manner. And he had his reward, for before his death his speeches were anxiously awaited, and the debates between him and his great rival Gladstone, the leader of the Liberal party, were some of the keenest that had ever been held in the House of Commons. Disraeli was especially clever at making catchy phrases. In 1846 when Sir Robert Peel, the Tory (Conservative) leader abandoned the position of his party and advocated the repeal of the Corn Laws—a Whig measure—Disraeli declared that Peel had "caught the Whigs bathing and had walked off with their clothes."

Finally Disraeli became the leader of the Conservatives in the House of Commons, even though he was not a large landowner; for he had the brains which, after Peel's death, were so sadly lacking on that side of the house. Under his leadership the Conservatives no longer opposed all progressive measures, and in 1867 he persuaded them to "dish the Whigs" by carrying through a Parliamentary Reform Bill extending the right to vote even further than the Whigs (Liberals) had suggested.

In 1868 Disraeli realized the "wild ambition" of his first years in Parliament and became prime minister as head of the Conservative party. His ministry fell within a year, but in 1874 he was again called to the premiership, this time remaining in office for six years. As premier he was much more acceptable to Queen Victoria than was Gladstone. He himself explained this partiality by saying that "Gladstone addressed the Queen as a public meeting, but he (Disraeli) addressed her as a woman."

Disraeli's foreign policy kindled the British imagination by picturing a far-flung empire bound together in an indissoluble union. He was the founder of modern British imperialism. He purchased for Britain from the bankrupt Khedive of Egypt his shares in the Suez Canal and so safeguarded England's route to India. He captured the fancy of the British, as well as of her temperamental Oriental subjects, by having Queen Victoria proclaimed "Empress" of India. He played a clever part against Russia in the Congress of Berlin (1878), blocking her progress in the Balkans and saving Turkey.

When he brought back "peace with honor" from Berlin, he was rewarded by the Queen with the title Earl of Beaconsfield and a seat in the House of Lords. In the elections of 1880 the Conservatives were defeated and he retired from office, dying within a year thereafter. But Conservatives still cherish his memory and on the anniversary of his death members of the Primrose League wear his favorite flower, the primrose.

Disraeli's success as a writer was due largely to his political experience, for he was the first successful author of political novels. Some of the best known of Disraeli's writings are 'Vivian Grey' (1826); 'Henrietta Temple' (1837); 'Coningsby' (1844); 'Sybil' (1845); 'Tancred' (1847); 'Lothair' (1880).

DISTILLATION. In many parts of the world the only sure way of getting pure drinking water is by the process called distillation. This consists simply of catching the steam from boiling water and cooling it until it turns back to liquid form. Water so obtained is pure, for the rising steam does not carry with it any of the solid impurities from the original water.

Any liquid, if you get it hot enough, will boil and give off vapor, which may be cooled and condensed in the same way as steam; hence distillation finds many other important uses. Chief of these is the process called "fractional distillation" employed in producing, among other things, gasoline and kerosene from crude petroleum, in making alcohol, perfumes, etc.

This process rests upon the principle that different substances will boil at different degrees of heat. If you heat a mixture of water and glycerin, for example, the water will begin to turn to steam long before the glycerin gets hot enough to give off its vapor. By keeping the temperature high enough to vaporize the water, but not high enough to vaporize the glycerin, you can collect and condense the water vapor, leaving the glycerin behind. In the same way, when petroleum is heated the gasoline will come away before the kerosene.

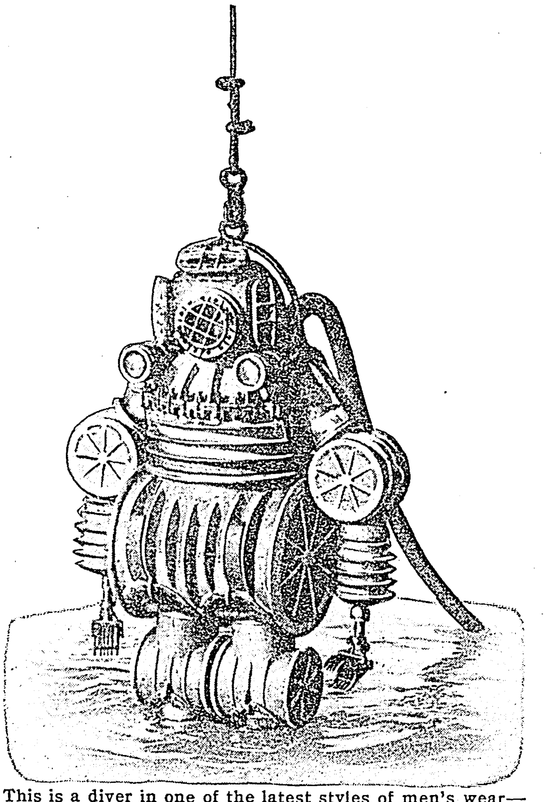
DIVING. The man in the deep-sea diving suit is a modern knight in armor. He battles not against cold steel but cold water, in fluid darkness fathoms down. The very air he breathes is supplied by patient men ashore or in a boat above, slowly working an air pump. For every 10 feet he descends he sustains an added water pressure of nearly $4\frac{1}{2}$ pounds over every square inch of his body (*see* Water). Hence he must descend slowly, not outdistancing the rate at which the pumps can supply the proper air pressure; otherwise he may suffer great pain, bleeding at the nose, eyes, and ears, and even losing consciousness or dying. And he must ascend even more slowly lest air be forced into his tissues, causing extreme torture, or lest he literally burst from internal air pressure.

The greatest depth ever reached by a diver is 420 feet. Max E. Nohl established this record when he descended to the bottom of Lake Michigan in 1937. This record, of course, applies only to diving with rubber suits, where the internal air pressure must equal the external water pressure. But by using a steel ball, called a bathysphere, fitted with quartz windows and oxygen tanks, Dr. William Beebe and Otis Barton were lowered to a depth of more than 3,000 feet in the sea off Bermuda, with no ill effects.

Perhaps the most interesting work of the diver is the salvaging of treasure and wrecked ships. Nearly 25 million dollars in gold bars were recovered in this way from the hull of the *Laurentic*, a British vessel sunk off the coast of Ireland during the World War. This is believed to be the greatest single treasure ever brought up out of the sea.

In the construction of bridges, dams, under-river tunnels, waterworks, etc., divers survey for foundations, caissons, and pile-settings. Waterworks in large cities employ a diver constantly. The United States Navy trains divers in huge steel-pressure tanks, thus artificially reproducing deep-water conditions, and employs many—at least two to every battleship—to set submarine mines, locate lost torpedoes, and examine ships' bottoms. Deep-sea divers are also used in several industries, as in fishing for pearls, corals, sponges, and shells, although dark-skinned swimmers of the tropics often perform such work without any equipment. Some of these natives can dive to great depths and remain under water two or more minutes.

THE ARMORED KNIGHT OF TODAY



This is a diver in one of the latest styles of men's wear—hardware, obviously. The heavy armor is for resisting the tremendous pressure of the water at great depths. The steel "hands" are worked by the man inside. Notice the electric lights on both sides of the neck, for guiding the diver in his work in the dark world to which he is being lowered by a rope attached to headpiece of the diving suit.

Diving dress or armor may be of metal or rubber. Perhaps the most efficient suit is one of aluminum alloy, weighing about 500 pounds. The helmet is usually of copper, with "windows" covered with thick glass. Leaden weights are attached to enable the diver to descend rapidly and the shoes have lead soles to enable them to keep their balance, feet down. They communicate with fellow workers on the ocean bottom and with attendants above by cords, speaking tubes, or telephonic apparatus. Air is supplied from a pump above through a flexible tube entering the helmet. The poisonous breathed air escapes either through another tube leading out from the back of the helmet, or through an ingenious valve arrangement.

Some suits are "self-contained," making the diver independent of any connection with persons above water. In one such suit a compressed-air reservoir on the diver's back supplies him with air by a self-regulating apparatus. When he wishes to ascend he simply inflates his dress from the reservoir. In another form the air breathed is filtered and regenerated by means of an oxygen helmet. The oldest successful diving apparatus, still occasionally used, is the diving bell, a big iron cylinder closed at the top and open at the bottom. When this is lowered into the water the air in it keeps the water out. Fresh air is pumped in from above and a special arrangement allows the foul air to escape.

MASTERING *the Art of* DIVISION

DIVISION. Dividing a number is separating it into equal numbers. It is of two kinds, *Measure* and *Partition.*

In the first kind, one of the equal numbers is given and the problem is to find how many such are contained in the number divided.
Example: How many 9's in 36?

The number divided is called the *Dividend.* In the above example 36 is the dividend.

The given one of the equal numbers into which the dividend is separated is called the *Divisor.* In the above example 9 is the divisor.

The result, or number of times the divisor is contained in the dividend, is called the *Quotient.* In the above example 4 is the quotient.

"Measure" Division

Measure is the kind of division the carpenter uses when he measures the wall with a 2-foot rule by dividing it into equal parts of a given size (2 feet).

As he measures he says to himself, 2, 4, 6, 8, 10, 12, etc. When he wishes to saw a board into equal lengths, he lays off the distances in the same way so as to divide it into equal parts of a given length. He then counts the number of parts.

But it is possible to avoid actual measuring with a ruler and also to find relations that cannot be found by measuring spaces. This is done by counting so as to measure one number in terms of another. Thus a carpenter knows that a 16-foot board can be divided into 8 two-foot spaces by counting 2, 4, 6, 8, 10, 12, 14, 16, and observing the number of 2's. In this way he measures 16 in imagination and finds it 8 times 2. The bank teller knows in the same way that a $10 bill equals five $2 bills. This is a fact that could not be discovered by physical measuring.
Examples:

1. A boy with 35 cents wishes to find how many pears worth 5 cents apiece he can buy. He counts by 5's thus: 5, 10, 15, 20, 25, 30, 35; and notes how many 5's he has counted. Thus he measures the 35 by using the 5 as a measure. He finds that where 35 is divided into 5's, it is seen to be composed of 7 of them. In the same way, a line 35 inches long if divided into 5-inch lines is found to be made of 7 such lines. So 35 of any thing divided into groups of 5 of the same thing equal 7 groups. This is expressed thus: 35 divided by 5 is 7, or $35 \div 5 = 7$.

2. How many $5 bills are required to make $35?

3. How many square yards of plastering are there in a ceiling containing 648 square feet? $648 \div 9 =$ what?

4. How many gallons in 24 quarts of milk? 24 quarts $\div$ 4 quarts = what number?

5. How many 4-inch strips can be cut from a piece of ribbon two feet long? Only like quantities may be compared by division. Hence we must first convert the feet into inches (2 feet = 24 inches), and state the problem thus: 24 inches $\div$ 4 inches = what?

"Partition" Division

When a given number is divided into a number of equal parts, the process is called *Partition.*
Examples:

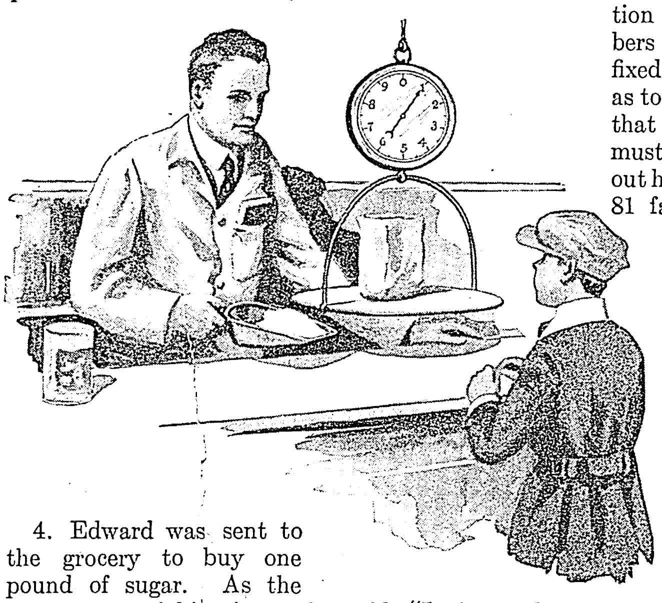
1. If a 12-foot board is sawed into 3 equal parts, how long is each part?

2. If Kenneth divides 12 marbles equally among 3 boys, how many marbles will each get?

Evidently the carpenter must divide the board into thirds and the boy must divide the marbles in a similar way. However, he can distribute the marbles one

at a time. Let him give Martin, Albert, and Henry each one, then each one more, and so on until all are distributed. Kenneth will give out 3 marbles each time around. Each boy will receive as many as there are 3's in 12, or 4. Hence we say one-third of 12 is 4, and by knowledge of this and other similar facts the carpenter is enabled to divide boards into a given number of equal parts. Knowing that $\frac{1}{3}$ of 12 = 4 ($12 \div 3 = 4$), the carpenter makes marks 4 feet apart with the assurance that the marks for sawing will prove to be in the right place.

3. Four boys earn 36 cents which they wish to divide equally. How much should each receive? $\frac{1}{4}$ of 36 cents = how many cents?

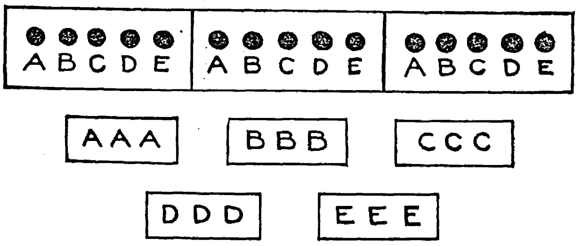


4. Edward was sent to the grocery to buy one pound of sugar. As the grocer was weighing it out he said: "Let's see how good you are at figures. I sell five pounds of sugar for forty cents. How much should I charge you for one pound?" What was Edward's answer?

5. A horse traveled 40 miles in 8 hours. What was the rate of travel per hour?

The Relation of Partition to Measure

Both kinds of division problems (*Measure* and *Partition*) are worked by the same process of calculation. Thus, if we wish to find how much $\frac{1}{5}$ of 15 is (*Partition*), we may find it from knowing how many 5's there are in 15 (*Measure*).



In this figure the 15 units have been divided into groups of 5. Call the units in each group A, B, C, D, E. If they are distributed to 5 persons, the first person will get the first unit from each group (the A's), the second person the second unit (the B's), etc., each person receiving 3; but each person receives $\frac{1}{5}$ of the total. Therefore, "$\frac{1}{5}$ of 15 is 3" is true because the number of 5's in 15 is 3. Therefore, any Partition problem may be calculated by the same process as a similar Measure problem.

1's	2's	3's	4's	5's	6's	7's	8's	9's	
in									
1	2	3	4	5	6	7	8	9	=1
2	4	6	8	10	12	14	16	18	=2
3	6	9	12	15	18	21	24	27	=3
4	8	12	16	20	24	28	32	36	=4
5	10	15	20	25	30	35	40	45	=5
6	12	18	24	30	36	42	48	54	=6
7	14	21	28	35	42	49	56	63	=7
8	16	24	32	40	48	56	64	72	=8
9	18	27	36	45	54	63	72	81	=9

In order to compute division, it is necessary to know certain elementary facts. The association of these numbers must be so fixed in the memory as to be automatic, that is, the results must appear without hesitation. The 81 facts indicated in the above table are fundamental and should be practiced upon until they are thoroughly familiar.

Accuracy and speed in division are acquired in these ways: (1) by mastering the "fundamental facts," or division tables; (2) by computing with as few words in mind as possible; (3) by care in writing each figure so that it falls directly in line with those above it; (4) by mentally testing the correctness of a figure in the quotient before writing it; (5) by testing the final answer.

For practice in the fundamental facts as involved in uneven division, that is, when the divisor is not contained an even number of times in the dividend, the following exercises will be found helpful.

Find quotients:

2)4	2)10	2)16	3)9	3)27	3)33
2)5	2)11	2)17	3)10	3)29	3)35
4)12	4)20	4)36	5)25	5)30	5)45
4)13	4)23	4)38	5)27	5)34	5)48
6)42	6)54	6)36	7)21	7)49	7)63
6)47	6)59	6)40	7)24	7)52	7)69
8)24	8)40	8)72	9)36	9)54	9)81
8)27	8)45	8)79	9)41	9)62	9)89

Short and Long Division

There are two forms of division: *short division* and *long division.* Short division is used in dividing by a number of one figure. In this form of division only the figures in the quotient are written. The rest of the calculation is carried in the mind.

$$\begin{array}{r} 480 \\ 2\overline{)960} \end{array}$$

Find the quotients in these exercises by short division:

1.	6)568	9.	5)24806	17.	5)84763
2.	8)9655	10.	6)85329	18.	7)34816
3.	9)15432	11.	9)46681	19.	9)6248
4.	7)98746	12.	6)15116	20.	6)5084
5.	10)76482	13.	5)5263	21.	4)49048
6.	8)200416	14.	3)2004	22.	3)15161
7.	7)4732	15.	7)19019	23.	2)14631
8.	4)2116	16.	8)34702	24.	4)648161

Long division is used in dividing by a number of two or more figures. Here according to the usual custom, the result of each step is written down. The order of work followed is: (1) divide; (2) multiply; (3) subtract; (4) form a new dividend. Repeat these four processes until all the figures in the dividend have been used. In dividing 4968 by 21, 49 is divided by 21 and the number 2 written in the quotient. The product found by multiplying 21 by 2 (42) is written under the 49. This product is subtracted from the 49, giving the difference 7. The next number of the dividend, the 6, is then brought down to form the new partial dividend 76. The process is then repeated.

$$\begin{array}{r} 236\tfrac{4}{7} \\ 21\overline{)4968} \\ 42 \\ \hline 76 \\ 63 \\ \hline 138 \\ 126 \\ \hline 12 \end{array} \quad \frac{12}{21} = \frac{4}{7}$$

Trial Divisors

To determine the true figures in a quotient, the first figures in the divisor and dividend are used as guides. $32\overline{)176}$ In dividing 176 by 32, since 3 is contained in 17 five times, it is taken as probable that 32 is contained in 176 five times, and 5 is written in the quotient. In dividing by such a number as 28 it can easily be seen that 28 is nearly 30 so $28\overline{)122}$ that it is better to use 3 as a guide in place of 2, and to think: since 3 is contained in 12 four times, it is probable that 28 is contained in 122 four times.

In dividing 246 by 39, we see that 39 is nearly 40. $39\overline{)246}$ Since 4 is contained in 24 six times, it is probable that 39 is contained in 246 six times. $48\overline{)374}$ So in dividing 374 by 48 we think of 37 divided by 5, which is 7. $97\overline{)228}$ In dividing 228 by 97, we think of 22 divided by 10, etc.

A figure in the quotient is known to be too large when the product is greater than the part of the dividend in use. It is known to be too small when the remainder is greater than the divisor.

In dividing, care is taken to place the first figure in the quotient directly above the last figure in the dividend used, and to place a figure in the quotient for each of the remaining figures in the dividend. Note that in the example at the left, the first figure in the quotient is placed above the fourth figure in the dividend, and since 82, the second partial dividend, does not contain 821, a zero is placed above the 2 in the dividend, and the new partial dividend 821 formed.

$$\begin{array}{r} 2010 \\ 821\overline{)1650210} \\ 1642 \\ \hline 821 \\ 821 \\ \hline 0 \end{array}$$

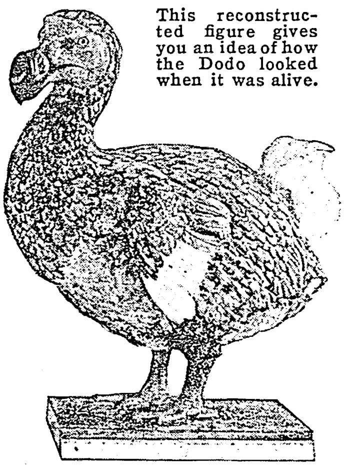
Find the quotients in these exercises by long division:

1.	9072 ÷ 21	15.	32046 ÷ 49
2.	22050 ÷ 42	16.	68748 ÷ 68
3.	44667 ÷ 63	17.	195702 ÷ 78
4.	10086 ÷ 82	18.	291388 ÷ 97
5.	39831 ÷ 51	19.	15249 ÷ 39
6.	29756 ÷ 43	20.	435888 ÷ 48
7.	29757 ÷ 91	21.	143278 ÷ 142
8.	29408 ÷ 32	22.	267167 ÷ 369
9.	60152 ÷ 73	23.	1056852 ÷ 525
10.	22356 ÷ 81	24.	1686656 ÷ 395
11.	3074 ÷ 29	25.	2489592 ÷ 406
12.	33630 ÷ 57	26.	1217958 ÷ 1234
13.	15466 ÷ 38	27.	3839112 ÷ 4506
14.	79344 ÷ 87	28.	2875166 ÷ 574

The usual test for division is to look at the quotient to see if it looks sensible and then to repeat the division. Another test is to find the *product* of the divisor and quotient, adding the remainder if there is one. The result should give the dividend.

DO'DO. "Simpleton" (*duodo*) was the name that Portuguese explorers gave this grotesque bird when, in the year 1507, they discovered it on the island of Mauritius in the Indian Ocean. It seems to have deserved its name, for it was so clumsy and stupid that it finally lost the struggle for survival and has been extinct since 1681. By the aid of drawings made by artists accompanying the early explorers, some bones discovered in a marsh in the island of Mauritius have been set in an almost complete skeleton of the dodo, now in the British Museum.

A FOOLISH BUT FAMOUS BIRD



This reconstructed figure gives you an idea of how the Dodo looked when it was alive.

In structure the dodo was related to the pigeon family, but it was not at all like a pigeon in appearance. It had a round fat body, twice as large as a turkey's, with short legs which could scarcely support its weight. Its tail was only a little tuft of curly feathers, its wings were small and imperfect and of no use for flying, and its head was very large, with an enormous hooked bill. It was so slow-moving that sailors hunted it with clubs, killing great numbers, and dogs and hogs completed its extermination.

A near relative of the dodo, the solitaire, which was also a gigantic flightless pigeon, inhabited the island of Rodriguez, near Mauritius. It survived the dodo by about 80 years.

MAN'S OLDEST *and Most* FAITHFUL FRIEND

"A Man's Dog Stands by Him in Prosperity and in Poverty, in Health and in Sickness. He Will Kiss the Hand That Has No Food to Offer. When All Other Friends Desert, He Remains"

DOGS. Clouds were pressing down upon the mountain peaks and the Alpine traveler groping bewilderedly through the blinding snow storm staggered on and on through the deep drifts, and at last fell and lay motionless. A few moments later a sharp cheery barking was heard above the howling wind, and rushing over the frozen crust and plunging through drifts bounded a great St. Bernard dog. Suddenly coming upon the lost traveler he crouched down in a protecting fashion, half covering him with his huge thick-coated body while he licked his face and hands with a warm soft tongue, and allowed the half-frozen man to unfasten the little flask of liquor and the basket of food that hung around his shaggy neck. Then seizing the man's cap he darted off into the storm, returning joyously in a short time with a rescuing party of monks.

The St. Bernard possesses dog-like qualities at their finest. Charged with the duty of finding travelers lost in the snow of the Alps, these dogs have done their work with a loyalty that has won them undying fame throughout the world.

The hero of this tale was Barry, the most famous of those big brave dogs trained for this rescue work, who, during the 12 years he lived with the monks in their lonely Alpine monastery, saved more than 40 lives. His figure today standing in the Museum of Natural History in Bern, Switzerland, and the imposing monument erected to him in the Dog Cemetery in Paris serve as constant reminders to man of what a dog can do.

Among the many animals made use of by man, the dog, his faithful friend and companion, stands first of all. Long before there were any pictured records of man's history the dog was his tamed companion; his bones were even found with those of Stone Age man. Scientists say that early men developed dogs for hunting purposes from the wild wolves of their particular regions. These were wolflike dogs such as the Eskimos use today, or such as are shown us in Egyptian pictures over 5,000 years old. Most kinds of dogs that we know, however, have been developed within the last few centuries to meet man's needs or his whims.

But our dog friends of today still have many queer little ways of reminding us of their wolfish ancestors. The hunting dog bays—a reminder of hunting wolves baying to keep the pack together. The dog howls at night—the ancestral habit of calling the pack. He sometimes howls, too, upon hearing certain music—does it remind him of the pack? He turns around before lying down because his ancestors had to do so in tramping down a flat sheltered bed in jungle grass or drifted leaves. And he stealthily buries his bones—even if it is only in a hearth rug—just as his wild forefathers buried theirs in the wilderness in order to prevent their enemies sharing them. The dog has to thank his ancestors, too, for his marvelous sense of smell, acute hearing, keen eyes, sharp teeth, strong legs for running, lean muscular body covered with the coarse protective hair—all of which fit him for the active life of the hunter.

THE "DANDY" OF DOGDOM

The playful Pomeranian learns tricks quickly.

The Belgian poet Maeterlinck tells us that the dog is the one animal that can follow man all over the earth and adapt himself to every climate and to every use to which his master chooses to put him. A striking example of the useful work a dog can do was shown us in the World War of 1914–18. The dogs "had a paw in the war" from the start—as rat killers, as Red Cross dogs for feeding and aiding the wounded, as sentinels, as messengers, and even (in the Belgian army) as haulers of machine guns. About 10,000 of these four-footed soldiers were "doing their bit" at the battle front when the armistice was signed, while more than a thousand sled dogs were used in the

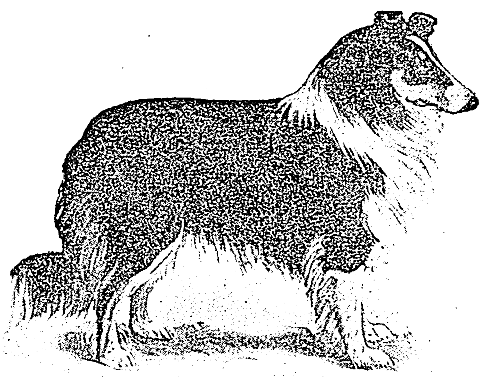
Vosges Mountains during the last year of the war for moving food and other supplies up to mountain trenches.

Dog Heroes in the First World War

And how gloriously these war dogs worked—dogs ranging from the Alaskan malamute to the noble St. Bernard, from the faithful Scotch collie to the wise little fox terrier! Bounding out into No Man's Land, with first-aid kits strapped to their collars, and hunting out the wounded; carrying big cans of hot soup through front-line trenches to cheer and strengthen the fighting men; stolidly mounting guard for hours at dangerous listening posts, their acute senses detecting an approaching enemy long before any man on such sentry duty could have done so; and plunging through barb-wire and a veritable hail of bullets to carry important dispatches or baskets of homing pigeons which were to carry messages farther than the four or five miles the dog could go.

Some dogs indeed proved veritable heroes and were mentioned in dispatches and decorated for bravery,

THE SHEPHERD'S INTELLIGENT HELPER



The long-haired Scotch Collie is the typical sheep dog of the world. It learns to know its charges so well that even in a crowded market it can adroitly separate them from other flocks. It also has an almost uncanny memory for places and directions.

as well as winning the devotion of countless soldier-friends. There was Fend l'Air, a black and white setter. When his master was buried by a shell explosion, the dog partially dug him out, then remained faithfully by his side for three days and nights, until finally he was rescued. There was Michael, the dog that unaided dragged his master—left for dead in No Man's Land—back to the trenches. There was Filax, the great sheep dog, who from time to time saved the lives of a hundred French soldiers lying wounded out in No Man's Land. And there were many others.

The Faithful Friend of Man

In times of peace the dog proves himself a useful friend in many ways. We all know what a difference there is in the looks of dogs. Compare, for instance, a huge 300-pound St. Bernard with a tiny Chihuahua which can stand on your hand and weighs less than two pounds; or a tall lithe greyhound with a little short-legged Dachshund; or a shaggy Newfoundland with those queer little sausage-like hairless dogs of Mexico or Africa. All of these "friends of man" have

THE DROVER'S SHAGGY FRIEND

This quaint-looking fellow with his bob-tail, the Old English Sheep Dog, is much used in England by cattle drovers.

as many different ways of serving him as they have colors and sizes and shapes. Only the expensive toy dogs—the Pomeranian, poodle, pug, Maltese toy dog, Pekinese, and Japanese spaniel—are developed merely as ornamental pets and have no real use except in the world of fashion.

"The dog is something of an aristocrat, ready for sport, keen on the watch, but not overly fond of work," says one writer. But we must not forget the sheep dogs, so knowing and hard working and useful. The Scotch collie, that honest wide-awake yeoman of the race, so loyal and intelligent, is now a favorite in every civilized land. When he has a flock of sheep to

HERE'S THE ONE WHO CAN HANG ON!

The Bulldog is famous for the mighty grip of his crooked jaws. But though he has a reputation for fierceness, today he's generally very good-natured.

care for, he lives with them, gathers them from the distant pastures, brings them to the fold when they are needed, and will let no prowler meddle with his woolly charges. It is a wonderful sight to see one of these

"HUSKIES" OF THE FROZEN NORTH

Eskimo dogs, or "Huskies" as they are sometimes called in Alaska, are not very far removed from the wolf in appearance or disposition. But these wiry deep-chested animals are among the most useful members of the dog family. They will drag heavy loads under the most trying conditions. Harnessed to a sledge a team will cover 60 miles day after day.

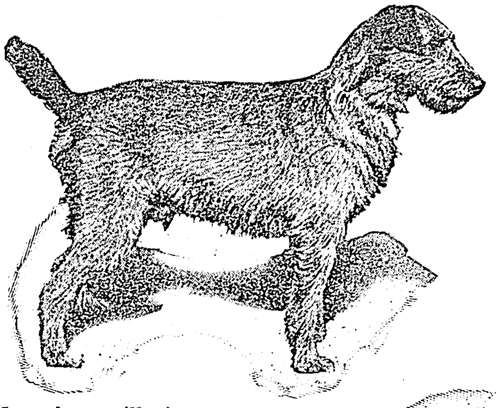
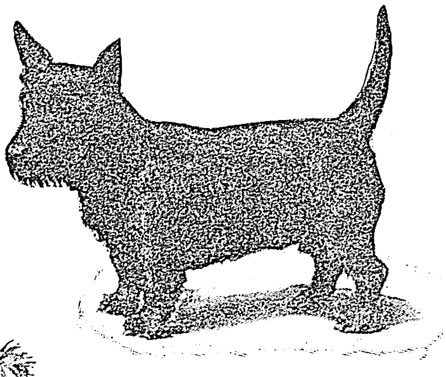
shepherd's assistants, at the sound of his master's whistle, scouring hill and dale, rounding up his flock—which may mean separating it from other sheep—guarding it, keeping it from straying or stampeding, and finally, without losing any of it, bring it safely home. Because of his remarkable sense of smell—so important a trait of all dogs—the collie and other shepherd dogs can trace and find sheep lost in snow storms.

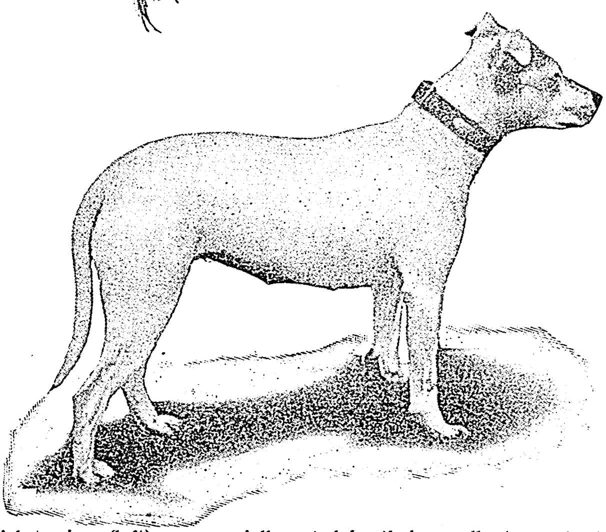
The collie's skill in his native Highlands is charmingly portrayed in Ollivant's 'Bob, Son of Battle'—a book all lovers of collies should read—and many true tales are told that show how intelligent these animals are. Among them is the story of the American shepherd whose death in a lonely cottage remained undiscovered for two days. During this time his two dogs tended the flocks as usual, taking them to pasture, guarding them, and driving them back home again each night.

The Dogs of Holland and Belgium

Other dogs who work for a living are those in Holland and Belgium which are used to pull their masters' milk-carts, and to haul vegetables and other produce. Still others do their farm and household bit in harness in certain parts of Canada. Perhaps the most useful of all the working dogs are those of the Eskimos and other northern residents—wolflike dogs which, in teams of a half-dozen or more, draw the sledges that furnish most of the winter transportation in the Canadian and Alaskan wilds. These devoted hard-working animals have indeed played a noteworthy part in many Arctic and Antarctic explorations. Most of us already know the type through Jack London's story, 'The Call of the Wild'. As one writer puts it: "Is a pole to be discovered, man stands powerless before the ice and snow without the dogs of the North. Is an expedition to reach the interior of a bleak region in dead of winter to rescue some hapless explorer or pioneer, or to help an ice-besieged population fight an epidemic of fever or smallpox, then the sleds and the dogs make the trip possible." Dog-racing in the Far North is one of the chief winter sports, and when one of the racing teams finishes a 412-mile race over ice and snow in (let us say) 80 hours and 27 minutes, the excitement of the crowd gathered to see the finish is as great as over a baseball world's series.

FOUR HIGHLY POPULAR BREEDS



Irish terriers (left) are especially noted for their excellent constitutions and their ability to rough it. Scottish terriers (right) need lots of exercise. Pekingese (center) are content to lead a sheltered indoor existence. Bull terriers (below) always want to be up and doing, and do not make such good house dogs as the others.

Most dogs will give warning of the presence of strangers or of danger, but some breeds are specially trained to be guardians of persons and property. Among the breeds that make the best watchdogs are the mastiff, the bull mastiff, the great Dane, the German shepherd, the bull terrier, the bulldog, and the boxer.

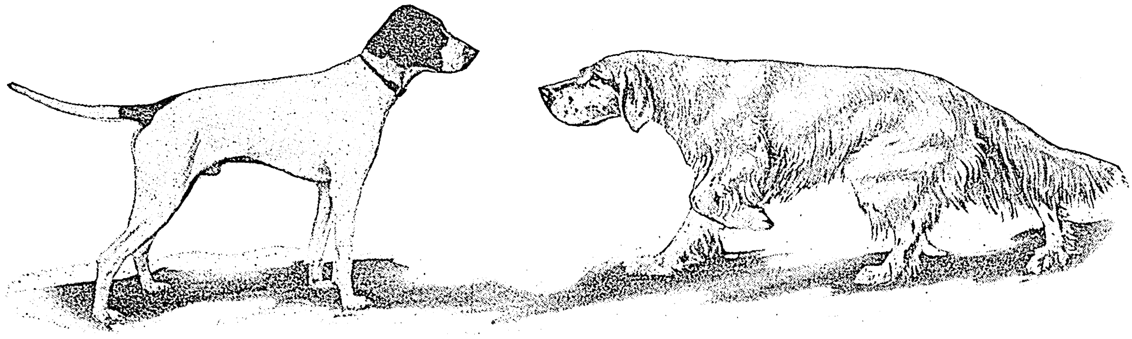
Because of their size, strength, courage, and rather ferocious appearance, these breeds are admirably suited for their task. As the name implies, the bull mastiff is a cross between the mastiff and the bulldog, developed to get the scenting powers of the former with the tenacity of the latter. They are especially useful for guarding large estates. The great Dane and the bull terrier are special favorites as protectors and companions for children.

Hunting and Working Dogs

The aristocrats of the dog world are the hunting dogs. While every dog "knows with his nose," it is the bloodhound and the others of this class that have the most astonishingly keen scent. Like their wild ancestors they learned the trick of following the scent of one animal through the confusion of many other smells, and learned, too, even to pick up a trail on the farther shore of running water. The bloodhounds, those good-sized tan or black and tan creatures with their somber wrinkled faces and long floppy ears, were used in former times for tracking wounded animals. During the last century, however, they have been used chiefly by the police department in chasing down criminals. So remarkable is their scent, it is said, that they can follow a trail 30 hours after it is made.

Most of the hunting dogs are also splendid runners. One of the swiftest and most graceful is the tall slender greyhound, called the "swallow among dogs." He hardly seems to touch the ground as he darts along. Another graceful runner is the beautiful Russian wolf hound, which also is tall and thin, and is noted for its wonderful silky coat—usually white with tan markings. There are many other hounds that chase the elk, gazelle, otter, deer, and other game. One of the most popular hunting dogs is the foxhound, that white and black and tan hound that has been used for centuries in the sport of chasing the fox. Large packs are kept in England and America for this purpose. The beagle and basset are smaller hounds that hunt hares and rabbits. Among the staunchest allies of the sportsmen we must not forget the dogs that merely help them to kill their game, or retrieve it after the

TWO ARISTOCRATS WHO HELP THE HUNTER



When the Pointer, at the left, scents a game bird in the grass, he stands perfectly still, with tail extended and nose pointed at the quarry. The Setter, at the right, does the same work in a different way; he crouches or "sets" at the scent of the game.

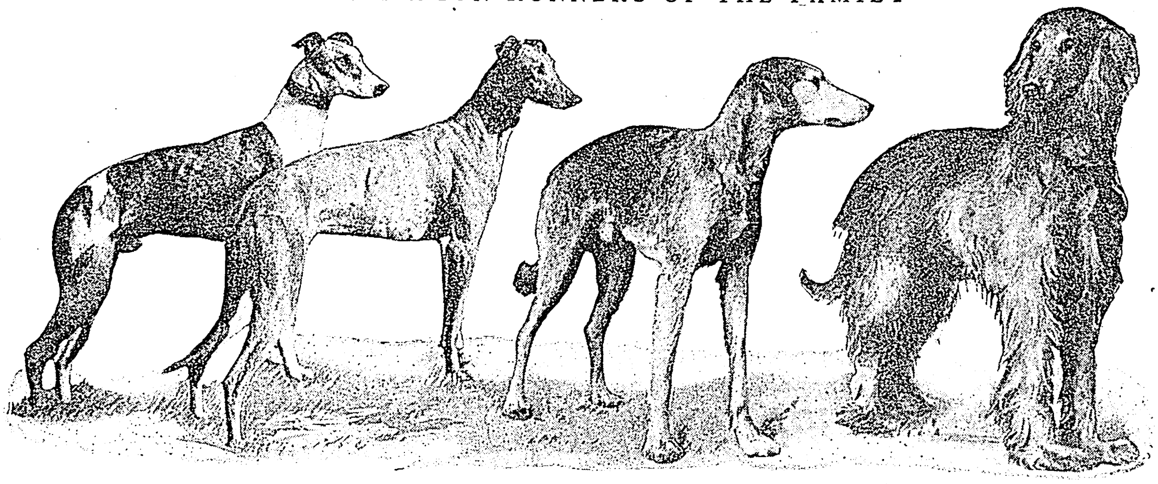
killing. There is the pointer, who stands rigid when he scents the game (usually partridge, grouse or quail), and points to it with his nose. The affectionate setter with his plumy tail and long silky coat is also useful in hunting feathered game. He was originally taught to indicate the presence of birds by crouching or "setting," but now he is usually trained to "point." Various sorts of spaniels and retrievers—most of which are fond of swimming—are useful in bringing back to the hunter the game which he has shot.

The little dogs too do their share in the world of sport. Foxes, badgers, rabbits, rats, and other animals which seek refuge in ground burrows beware of the terriers, those small usually shaggy dogs of many varieties which, as their name suggests, go to the earth (in French, *la terre*) for prey. They are bright plucky mischievous little rascals and do their work well. A single rat terrier was once let loose in a room where a hundred rats had been collected. Like a streak of lightning he worked and in seven minutes had killed every one of them, one hasty bite putting each rat out of business. From the little short-legged skye

"BIG AND LITTLE" IN DOGDOM

The patient "under-dog" of the piece is Boy Blue, a famous St. Bernard, while the pert little rider is "Wonderful Tiny," a Yorkshire terrier.

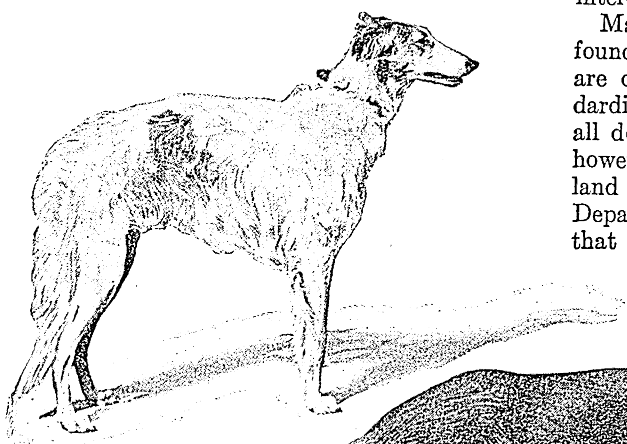
THE CHAMPION RUNNERS OF THE FAMILY



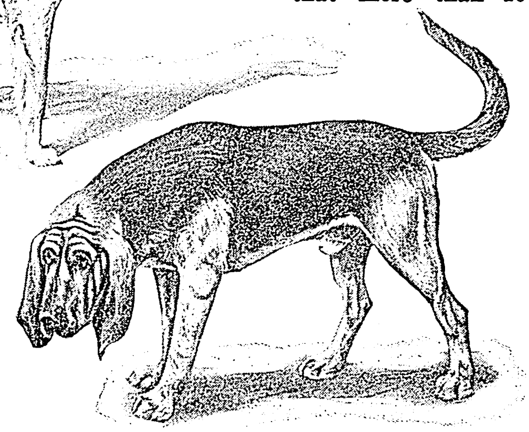
Greyhounds are an ancient breed of dog. They hunt by sight, and are a good match for even the swiftest animals. The two on the left are English Greyhounds; the third is a Deerhound, and the one to the right is the picturesque long-haired Afghan Greyhound.

terrier, half buried in his own hair, to the Boston terrier—the intelligent popular dog who shows traits of both his bull and terrier ancestors—the good-sized impetuous Airedale, and the bright jolly little fox terrier, these terriers are all knowing, tenacious, and self-reliant, and, if need be, will prove themselves "good sports."

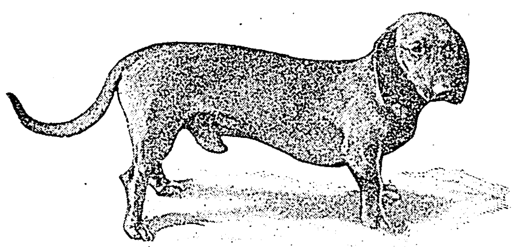
SOME STRANGE DOG TYPES



The Russian Wolfhound or "Borzoi" is often considered the handsomest of all dogs.



The Bloodhound, on the other hand, certainly has no claim to the beauty prize, but he is gifted with a keenness of scent that makes him a famous "trailer." Stories of the fierceness of the Bloodhound, however, have been much exaggerated.



The German Dachshund is one of the most curious members of the dog family. The story goes that his race was bred for those short crooked front legs, so he could crawl into holes after badgers.

About the most ridiculous-looking dog is the German dachshund (which means "badger dog"), who can enter a badger's hole and stolidly drag out his belligerent prey. Although he is an affectionate and a plucky watchdog, his long ungainly body and short crooked legs will prevent him from ever becoming popular with people who like good-looking dogs. In Germany it is often said that the dachshund is "sold by the yard!"

Yet, whatever the breed, the dog above all else means to us a quick-witted, plucky, faithful playfellow and protector, of whose unselfish devotion and other almost human qualities we have countless proofs. Dog lovers tell us many wonderful anecdotes of these knowing sympathetic tail-wagging friends of ours. Although some of these stories are so marvelous that they remind us strangely of certain "fish stories" we have heard, many authentic ones prove how clever, faithful, enduring, docile, loving, and unselfish our dog friends can be. Not all dogs lie down and die on their master's grave, unwilling to leave him even after death; not all dogs rescue people from drowning as do the shaggy water-loving Newfoundland; not all dogs do wonderful circus tricks; not all throttle burglars and perform various other heroic deeds; nor do many of them develop curious habits like the globe-trotting Owney, the railway postal clerk's dog, who traveled all over the world; or like Flock, the dog who insisted upon riding in airplanes. Yet we all know some dog who has done things almost as interesting.

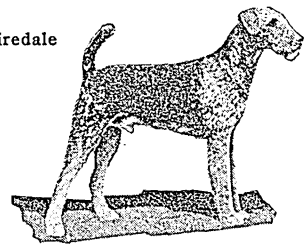
Many clubs and societies have been founded by dog lovers, and dog shows are often held with a view to standardizing and bettering breeds. Not all dogs are well-bred or well-trained, however. Among the criminals of dogland are the sheep-killers, and the U. S. Department of Agriculture estimates that more than 100,000 sheep are killed annually by dogs. The dog has also been known to spread diseases, the most terrible being rabies or hydrophobia. But in general the services of dogs to mankind have far outweighed the bad qualities of the few. (*See also* Pets.)

Scientists class dogs in the family *Canidae* of the order *Carnivora*. The breeds of domestic dogs (all of the genus *Canis*) have been estimated at more than 200, but their number can scarcely be counted, since every land has its favorites, developed to suit the sports and tastes, or even the climate and terrain of the country. New breeds are made by crossing known breeds to secure their good qualities for the created variety. The best of the new are carefully selected to produce the dogs that shall set the standard for their kind. Hunters have been most active in establishing breeds. Many varieties of dogs were originated by cross-breeding to obtain special hunting qualities.

In many countries, dog breeders, or "fanciers," are banded together in associations to further the interests of the thoroughbred dog, or of a particular breed. The American Kennel Club recognizes more than 80 breeds, and keeps adding to this list. At its shows, winning dogs of each class are awarded ribbons, prizes, and some of the 15 points needed to place the title "Champion" before their names. This organization registers the pedigrees of thoroughbreds. Leading breeds of dogs are described on the next two pages.

Afghan Hound.—Rough-haired, long-eared coursing dog, bred for centuries in Afghanistan.

Airedale



Airedale Terrier.—Large terrier with wiry coat; tan with black or grizzled saddle; excellent water dog.

Basset.—A small, short-legged, long-eared hunting dog.

Beagle.—A small hound, sturdily built, with smooth coat and long ears.

Bedlington Terrier.—Wiry haired terrier with long ears and silky topknot; about 15 inches tall; blue-gray, liver, or tan.

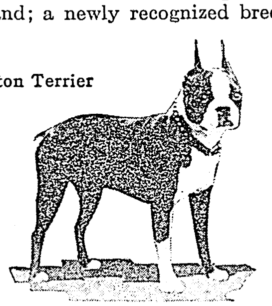
Belgian Sheep-dog, or Shepherd.—Similar to German shepherd, but smaller; used for police work and herding.

Black-and-Tan, or Rat Terrier.—Smooth black coat marked with tan; miniature of Manchester terrier.

Bloodhound.—Good-sized dog; black and tan or red-brown and tan; smooth hair and loose skin lying in folds on forehead; long ears and chops, giving a mournful expression; keen scent.

Border Terrier.—Small able terrier from the borderland of England and Scotland; a newly recognized breed.

Boston Terrier



Boston Terrier.—Smooth coat, short head, with erect ears; brindle to black with white markings; both toy and medium-sized varieties.

Boxer.—German dog resembling the Boston terrier.

Briard.—French herding dog similar to the Old English sheep-dog.

Bulldog.—Low heavy dog, with undershot jaw and retreating nose.

Bulldog, French.—Small bulldog with upstanding "bat" ears.

Bull Terrier.—White, smooth-coated, medium size; agile and courageous; "Yankee terrier" or "American terrier" has color markings.

Cairn Terrier.—A small terrier from Scotland, having a long harsh coat.

Chesapeake Bay Dog.—A large dog, probably descended from the Newfoundland; dull brown; broad head and drooping ears; used as retriever.

Chihuahua Dog.—Tiny fine-haired dog, developed in Mexico; reddish, black, or fawn.

Chow Chow, or Chow Dog.—Native of northern China, of medium size and sturdy build, with large broad head,

Chow Chow

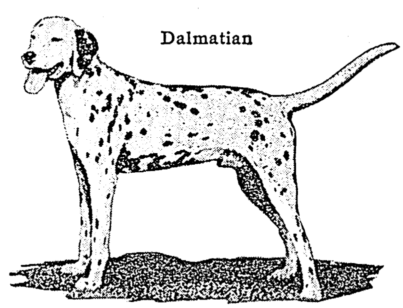
short erect ears, blue-black tongue, thick hair, and bushy upcurled tail; usually reddish brown or black.

Clydesdale. *See* Skye Terrier.

Collie.—Large, thick-furred, with long tapering nose; golden brown with white mane, or tan, black, and white, or all white; much used for herding; the smooth-coated collie is rarer.

Dachshund.—Short-legged, long-bodied German dog, with hound-like head.

Dalmatian



Dalmatian.—Strong, muscular, with short smooth hair; white with small black or liver-colored spots; also called coach dog.

Dandie Dinmont Terrier.—Long-bodied, short-legged, with rough coat, silky topknot, long ears; pepper or mustard color.

Deerhound, Scottish.—A large hunting dog, more heavily built than a greyhound, and with rough coat.

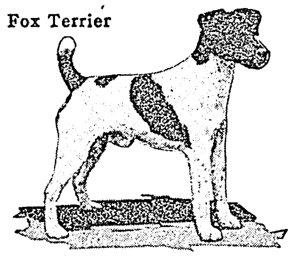
Dingo.—Wild dog of Australia, in danger of extermination because it kills sheep; some have been domesticated.

Elkhound, Norwegian.—One of the wolf-like dogs from which shepherd breeds have been developed.

Eskimo Dogs.—Several kinds of wolf-like dogs used to pull sleds; malamute, husky, and North Greenland Eskimo are varieties.

Foxhound.—An able hunting dog; American breed is lighter and rangier than the English.

Fox Terrier



Fox Terrier.—A small, sturdy, active dog; one variety smooth coated, the other wire-haired; white with black and tan markings.

Great Dane.—A very large strong dog, agile and symmetrical, with head carried high; hair short; brindle, fawn, gray, black, white, or white with black patches (harlequin).

Greyhound.—Fleet, slim, long-limbed coursing dog, used from ancient Egyptian days; brindle, fawn, black, and white.

Griffon.—Rough-coated German or French hunting dogs.

Griffon, Brussels.—A small rough-coated toy dog, reddish brown; pug nose; heavy "mustaches."

Harrier.—Dog resembling foxhound, but smaller; used to hunt hares.

Irish Terrier.—Medium size, rough hair of reddish color; noted for gameness.

Kerry Blue Terrier.—Irish dog with soft coat of bluish tint; V-shaped drooping ears; water dog.

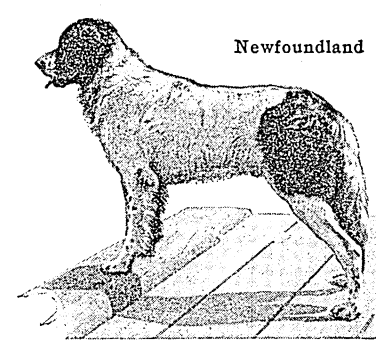
Lhassa Terrier.—Toy dog from Tibet with long heavy coat.

Maltese.—Active toy dog, of sharp terrier appearance, with long silky white hair.

Manchester Terrier.—Medium-sized, smooth-coated; black with mahogany tan markings.

Mastiff.—Ancient breed, large, powerful, from which many other breeds have been developed.

Newfoundland



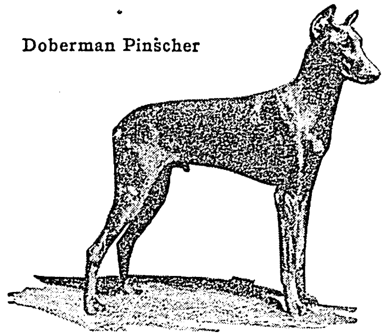
Newfoundland.—Massive head and square muzzle; long thick hair; usually black, or black and white; brave and devoted.

Old English Sheep-dog.—Moderate size, with broad head, thick-set body, and long shaggy hair which falls over face and eyes.

Otterhound.—Large, with head similar to bloodhound; thick wavy grayish coat, used to hunt otters along streams.

Papillon, or Butterfly Dog.—Toy dog with abundant silky coat; long bushy tail, and ear resembling a butterfly.

Pekingese.—Small lap-dog with long silky hair, broad head, short muzzle, large protruding eyes, squat legs; reddish, fawn, black, sable, and mixed.


Doberman Pinscher

Pinscher, Doberman.—Smooth, moderately large, muscular; black and tan, or brown; developed in last half century in Germany; used there as a police dog; one miniature variety.

Pinscher, Wire-haired. *See* Schnauzer.

Pointer.—Excellent bird hunter developed from old Spanish pointers and speedy foxhounds; smooth coat; white with black, liver, or lemon markings.


Police Dog

Police Dog. *See* Shepherd, German.

Pomeranian.—Toy, long-haired dog, with fox-like expression; sable and orange usual colors; differs from Spitz chiefly in size.

Poodle.—Curly-haired, usually white or black; often displaying intelligence, especially in learning tricks; toy, curly, and corded varieties.

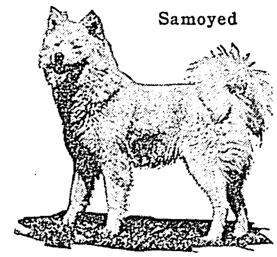
Pug.—Small with round head and short blunt square muzzle; fawn with black shading, or black.

Pyrenean Sheep-dog.—A mastiff-like dog used to protect flocks from wolves in the Pyrenees; has been cross-bred to develop St. Bernard and other breeds.

Retrievers.—Dogs trained to retrieve dead or wounded game; large, usually black or liver-colored, resembling Newfoundland and setter; varieties are the curly-coated, flat-coated, and Labrador retrievers.

St. Bernard.—Very large, with massive head; either long and rough, or smooth coat; originally bred at the Hospice of St. Bernard in the Alps.

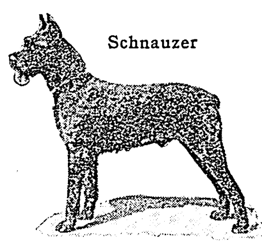
Saluki, or Persian Gazelle Hound.—One of the oldest historic breeds; introduced into the West from the Orient; large, speedy, and graceful, like the greyhound, with silky coat; hunts by sight and does not bark.


Samoyed

Samoyed.—A strong, medium-sized, thick-furred white dog from Asiatic Russia. Used as sledge dog.

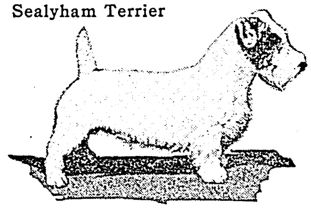
Schipperke.—Small, black, with fox-like head, erect ears, square and firmly-built body, thick hair, docked tail; name is Flemish for "little skipper," coming from its use in Flanders as watch dog and ratter on barges.

Schnauzer.—Strongly built German dog; pepper and salt coloring; wire coat, bristling mustache and beard; miniature, medium, and giant, or *riesenschnauzer* varieties; also called wire-haired pinscher.


Schnauzer

Scottish Terrier.—Long stocky body and short legs; rough hair; black, gray, sandy, or grizzled.

Sealyham Terrier.—Developed in Wales; long body, short sturdy legs, wiry hair; mainly white, with occasional markings of brown, tan, or yellow.


Sealyham Terrier

Setter, English.—Bird-hunter of medium size with long coat; white, with liver, tan. orange, or black blotches.

Setter, Gordon or Black-and-Tan.—Similar to English setter; coat black with mahogany-tan markings.

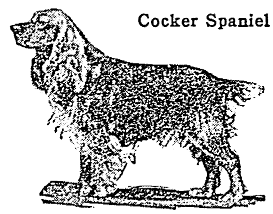
Setter, Irish.—Somewhat lighter in build than the English setter, with long, flat, glistening red-brown coat.

Shetland Sheep-dog.—A small collie.

Shepherd, German.—Large dog with wolf-like head; black, white, gray, or mixed; popularly called police dog; known as Alsatian in England.

Skye Terrier.—Small with long hard hair falling to the ground; Clydesdale terrier similar but with silky hair.

Spaniel, Clumber.—Medium height with massive head and frame; white with lemon or orange markings.


Cocker Spaniel

Spaniel, Cocker.—Moderate-sized; varied color markings; long drooping ears; broad feet; quick and alert.

Spaniel, English Toy.—Round head and pug face; varieties: King Charles, black and deep brown; Prince Charles, white with black and tan markings; Ruby, mahogany bay; Blenheim, white with chestnut markings.

Spaniel, Field.—Larger, heavier, and stronger than Cocker spaniel; all black, or white with black or other markings.

Spaniel, Irish Water.—Curly liver-colored coat, smooth face, and curly topknot; excellent water dog.

Spaniel, Japanese.—Small, resembles Pekinese; black or yellow and white.

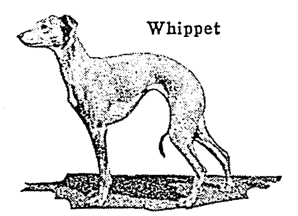
Spaniel, Springer.—So named because it was formerly used to drive out or "spring" the game; it now points; English and Welsh varieties.

Spaniel, Sussex.—Massive muscular hunter with abundant golden-liver coat.

Spitz.—Medium-size; heavy upstanding coat; probably related to Samoyed.

Welsh Terrier.—Wire-haired, resembles fox terrier; colored like Airedale.

West Highland White Terrier.—Small with long active body and short muscular legs; white wiry coat.


Whippet

Whippet.—Bred for racing; a cross between the greyhound and terrier.

Wolfhound, Irish.—Resembles deerhound, but more massive; with its high-held head, the tallest of all dogs.

Wolfhound, Russian, or Borzoi.—Tall, slender, graceful, with long tapering head and nose; silky coat.

Yorkshire Terrier.—A toy, long-haired terrier.

How to Choose and Train Your Dog

IT'S FUN to own a good dog because he is such an amusing companion, ready for almost any game, and yet more than earning his keep by acting as guard for the home and the family. How well a dog fits into the family circle depends, however, upon how wisely you select him, educate him, and care for him.

Practically all dogs, whether purebreds or just mongrels without pedigrees, have much the same chance to develop affection, patience, forgiveness, and loyalty. But there is less uncertainty about the future appearance and nature of your dog, if you select a purebred puppy. Crossbreeds or mongrels are not healthier than purebreds, as is often said.

The first step in teaching a young dog to lie down at your command. The text explains the method in detail.

Selecting a Dog

We may begin with the group of hunting breeds that includes the cocker spaniel, the springer spaniel, the beautiful setters, the pointers, and the retrievers. All these make delightful pets if you have room for them, but most of them are rather large. The cocker spaniel, smallest of the group, has become very popular.

The second group of hunting dogs are the hounds. They love the outdoors, are fast and very intelligent. Many of the dogs in this group are best suited for estates because of their size; for example, giant Irish wolfhound, Afghan, bloodhound, Scottish deerhound, and saluki. But among the hounds also are the dachshund and the beagle, two breeds whose small size, pleasant disposition, and smooth coats make them ideal household companions.

Next we come to the serious-minded dog workers which for years have been guarding property, hauling sleds, and herding sheep. They include the German shepherd (the breed commonly used to guide blind people); the German boxer, trained for police work; the alert, handsome collie; the speedy Doberman pinscher; the noble, majestic Great Dane; the affectionate Newfoundland; the sled dogs, such as the Eskimo or husky, and the Samoyed; the schnauzer; the huge St. Bernard; and others. These dogs are suitable for responsible owners who have homes with plenty of room. They need careful training and control. If you need a powerful watchdog, you will find him in this group.

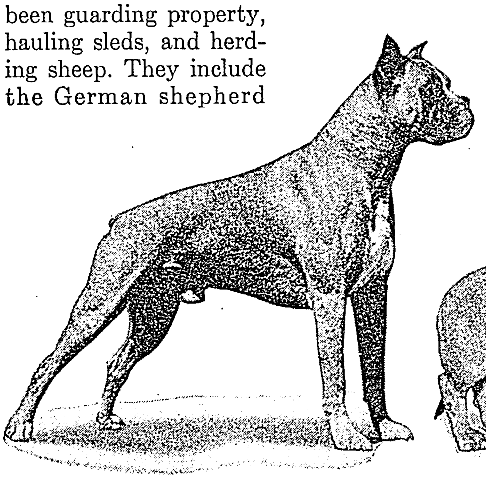
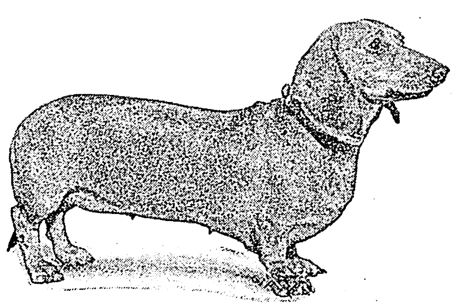
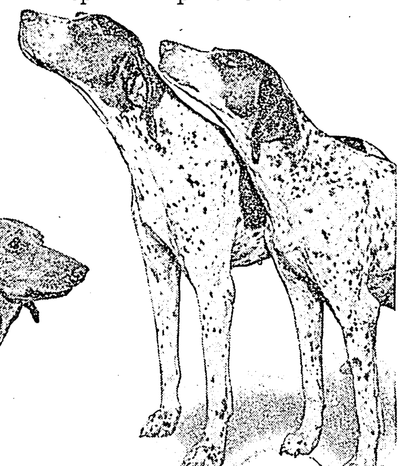
Long-haired dogs must be combed regularly for the sake of their appearance and the health of their skin.

The Terriers

The terriers include such breeds as the Airedale, the bull terrier, the gay plucky Irish terrier, the handsome Kerry blue, the distinctive Scotty, the lovable little Sealyham; the perky, energetic wire-haired and smooth fox terriers; and the schnauzers. These are high-strung dogs, full of life. Some of them may be noisy. But they have lots of personality and make amusing, faithful pets. They love children and will play any game with them. But most of the terriers have to have their coats "barbered" with a stripping comb if they are to look well and have healthy skins. This responsibility must be considered.

Toy Dogs and Specialized Breeds

Among the toy breeds are such distinctive dogs as the Pekingese; the alert and clever Pomeranian; the Chihuahua, the tiny dog from Mexico; the Manchester; the Maltese, a quiet and intelligent pet; and the long-haired Yorkshire. These midget breeds are affectionate, and easy to keep in an apartment.

CHAMPIONS ON PARADE

Show dogs are trained to display their best points as these champions are doing: left to right, a German boxer, a dachshund, and two pointers.

Finally, there is the group of highly specialized breeds. Among them we find the very popular Boston terrier; the English bulldog; the aristocratic and handsome chow; the Dalmatian or coach dog; the French bulldog; the keeshond; the poodle; and the little "barge dog" known as the schipperke. These breeds vary greatly in personality. If you like a small, very alert, inquisitive guard dog, choose the schipperke. The exact opposite is the aloof, dignified, undemonstrative chow.

How to Choose a Puppy and Train Him

It is usually best to get your dog while he is still a puppy. Be sure that he is healthy, with good legs and well-formed bones. Look for one that is not afraid of noises, that is a bit bold rather than shy. And don't be too partial to males. The female often is more devoted, cleaner, more considerate, a better guard for children, and easier to train.

One of the first problems with the new dog is to teach him his house manners. Out of doors housebreaking may be taught as follows:

Confine the puppy to a small box or any small space at night. He will try to avoid soiling his bed or the floor close to it. Take him out the first thing in the morning, saying as you do: "Out, out, want to go out?" Don't pet him until he has obeyed. Then make a fuss over him. Bring him back into the house and give him a tidbit to eat. Repeat this routine several times during the day. The pup will soon learn what is expected of him.

If the pup makes a mistake (most of them will during the training period), don't whip him. Just hold him close to the offense and say, "Shame, no, no-o." Let your voice and actions indicate that you are displeased with him and he will understand that he has done something wrong.

It is possible to housebreak a puppy to use papers or a low box of sawdust or sand. The routine is much the same as in outdoor housebreaking. The first thing in the morning place the little fellow on the sawdust or sand. Keep him there until he has sat down. Then take him from the box and praise him. Whenever you see him sniffing at the floor or showing any other "danger" signals, hurry him to the box. Don't forget that it may take more than a day or a week to teach a young dog his house manners.

Obedience and Street Manners

Here is the way to teach your dog obedience to the command "come": Take your dog outside where there are no other people or other dogs. Put a long cord around his neck. Let him run around as he pleases. When he is 15 or 20 feet from you call him like this: "Spot, come here." Give the command firmly and sharply, and then pull on the cord. If he doesn't come to you at once jerk him in. Then reward him with a tidbit. Repeat this several times. Then wait an hour or two and give him another training lesson. Soon you'll have the puppy coming to you when called.

Much the same system may be used to teach your dog not to run out on the street and chase cars. Just as soon as he goes off the curb, call him back and reward him. Repeat this many times from day to day. Then take him to the curb by his collar and hold him, saying, "Hold it, hold it," in a low, firm voice. Then say "All right" and run across the street with him. You'll be surprised how soon he will learn to stay out of the street unless you are with him.

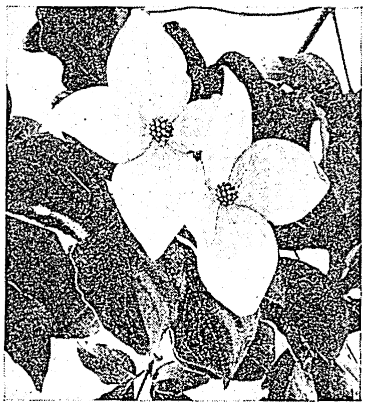
To teach a dog to "sit," call him to you. When he is at your feet, bend over, hold him with your left hand, and put your right hand on his back, as shown in the picture on the opposite page, then saying, "Sit, sit" or "Hupp, hupp," press down firmly until he is sitting down. Hold him there a moment or two, give him a reward, and then let him get up. Repeat this action, gradually keeping him down longer each time. When he stays down pretty well you can take your hand from his back, meanwhile repeating the command, and slowly bringing your hand in front of him, palm down. In a few lessons he'll learn the word "Sit" or "Hupp" and understand the hand signal as the command to sit down.

DOGTOOTH VIOLET. One of the earliest of the North American flowers to greet the spring is the dogtooth violet, or adder's-tongue. The plant is really not a violet but belongs to the lily family. The yellow, purplish, or white bell-shaped flower, with its delicate fragrance, is borne on a slender stem from 6 to 12 inches high, between two large flat shining leaves. It is found especially in moist places and along the banks of streams, and hence is sometimes called the "trout lily." The name "dogtooth" refers to the appearance of the bulbs from which the plants spring.

Scientific name of yellow dogtooth violet, *Erythronium americanum.* Leaves pale green mottled with purple; oblong, lance-shaped. Flowers single, rather large; 6 spreading or recurved sepals, 6 stamens, 1 pistil.

DOGWOOD. Of the many species of these hard-wooded shrubs and trees, most are found in the temperate regions of the Northern Hemisphere. They all belong to the genus *Cornus,* so named from the Latin word for "horn," on account of the hardness of the wood. One of the most showy species is the so-called flowering dogwood. It blooms in the early spring before its leaves unfold, and is found as far north as New England and westward to Minnesota. Its large "flowers" (really petal-like bracts) of white or pinkish hue make the tree a conspicuous and beautiful sight in the bare woods. The bitter bark has astringent properties and is sometimes used in medicine. Another handsome species is the western, or Pacific, dogwood, found in the Pacific Coast states. The ordinary bush forms, with red and greenish twigs and white, bluish, or red berries, are common throughout the United States. The wood of European dogwood is used in making charcoal for gunpowder and for many other purposes.

THE DOGWOOD "FLOWER"

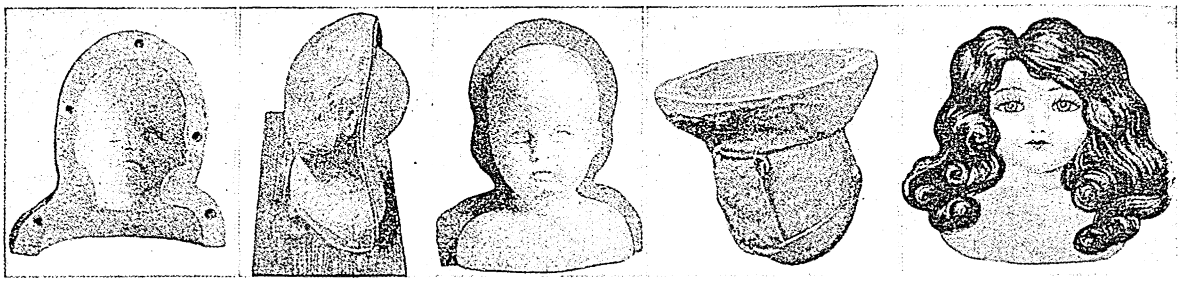


The Dogwood tree is among the earliest to bloom in the spring.

Scientific name of flowering dogwood, *Cornus florida;* of western, or Pacific, dogwood, *Cornus nuttallii.* Flowers green, tiny, perfect, growing in a rounded central cluster.

DOLLS. Was there ever a little girl who did not like to play with dolls? All over the world millions and millions of children are hugging dolls and talking to them in hundreds of different languages. What an interesting scene it would be if you could get together all of the many kinds of dolls! The little Eskimo girl dandles a rudely carved bit of whalebone with as

HOW CHINA DOLLS' HEADS ARE MADE



The common china doll heads are made in molds divided into two parts so that when the material has hardened the two parts can be separated and the doll's head taken out. The fourth picture shows how the two halves of the mold are tied together for filling with the clay.

much devotion as the little American girl pets her big and costly wax doll that opens and shuts its eyes and says "mamma." The pickaninny of the South makes a doll of a corn-cob wrapped in a bit of rag, and her far-away cousin in Africa contents herself with a bit of wood with clumsily carved features. In Japan girls play with kimono-clad dollies with black hair and slanted eyes, just like themselves; and in Mexico they have funny-looking dolls of baked clay.

A DOLL FROM EGYPT

Although crude, it satisfied the little Egyptian girl.

It has been the same in all ages. In the British Museum there are dolls more than 3,000 years old, found in tombs of the ancient Egyptians. They have flat bodies of carved and painted wood, and hair of clay beads strung on thread. The dolls of ancient Greece and Rome were an improvement over these, for they have well-shaped heads, and jointed arms and legs that can be moved by means of strings. Yet even so, they are very different from the talking, winking, real-haired dolls you know.

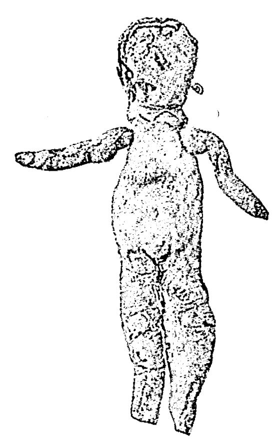
For many years Germany, the Netherlands, and Switzerland made dolls to supply the toy markets of Europe and the Western world. Then England, France, and America began to make dolls for their own markets. In the United States there are large factories that turn out 7,000 heads a day. More and more the dolls today are given heads and features like real children, though "kewpies," "brownies," "billikins," "teddy bears," and other eccentric character dolls are common. Mechanical dolls are frequently made, and unbreakable composition heads are replacing the perishable wax and china ones. Dolls are made of a great variety of materials—the unglazed pottery called bisque, rubber, wood, papier-mâché, etc.

MAKING A REAL "BEAUTY"

Nowadays doll-makers turn out truly wonderful playthings for little girls. Here is a doll-maker shaping a little head that is a real work of art. Many heads will be molded from this model.

DOLPHIN. Every ocean traveler is familiar with the dolphins, the small relatives of the whale, which escort steamers for miles across the sea, apparently delighting to leap from the sea and to exhibit their swimming tricks to human spectators. Probably because of their friendliness, no creatures of the ocean have ever been surrounded with more myth and romance (*see* Arion). It is a sailor's superstition that bad luck will come to anyone who harms one of these sea-clowns, and when the churning propeller of a steamer cuts up an inexperienced young dolphin, the old deck hands shake their heads in warning.

A DOLL OF OLD ROME



It is at least more life-like than its Egyptian relative.

The dolphin is frequently mistaken for the porpoise. The "schools of porpoises" described by many seafarers are in reality dolphins, for the true porpoise seldom ventures far from shore (*see* Porpoise). Unlike the porpoise, the dolphin has a sharp beaklike nose, but otherwise these sea mammals resemble each other closely. The common dolphin is six to eight feet long, and is very dark brown above and white underneath; it feeds upon fish. The tail is flattened horizontally instead of vertically, like a fish's tail, and the dolphin has other peculiarities of the whale family (*see* Whale).

Some species swim up the mouths of rivers, especially in South America. They are not a staple article of food, although seamen occasionally defy superstition and catch a dolphin in order to enjoy the rich oily meat.

The Greeks used the dolphin as a symbol of the sea, and to the early Christians it was a symbol of the dead. The name dolphin is also given to a swift fish of the open sea, which often attains a length of six feet. They are of a brilliant golden-blue with deep blue spots, but the colors fade rapidly when the fish is taken from the water. Scientific name of common dolphin, *Delphinus delphis;* of dolphin-fish, *Coryphoena hippurus.*

DOMESTIC SCIENCE. The name given to a group of subjects, now usually called Home Economics, taught in schools and colleges with a view to preparing girls to be "home-makers." The courses deal with foods and their preparation, textiles and other clothing materials, household sanitation, etc. (*See* Home Economics.)

DOR'MOUSE. This small animal of squirrel-like habits, a native of the Old World, is related to both the mice and the squirrels and is in structure intermediate between them. It lives in trees and bushes, feeding on nuts and berries, and sits erect on its haunches like a squirrel when eating. It lays up a store of food for winter, and when cold weather comes it curls up in its nest and sleeps. On warm days it is likely to wake, eat, and fall asleep again. Its name means "sleeping mouse." Dormice are tamed and kept as pets. In the United States the common white-footed mouse is often called dormouse.

DOUGLAS, STEPHEN ARNOLD (1813–1861). Though a New Englander by birth, having been born at Brandon, Vt., Stephen A. Douglas early identified himself with the new West, and for a time was regarded by the slaveholding South as its most promising champion. At the age of 20 he moved to Illinois and there began the practice of law. Politics soon claimed his attention, and from 1835 until his death he held office, either in the state government or in Congress.

It was in the United States Senate that he won his chief fame as author of the Kansas-Nebraska bill of 1854. This gave popular (or "squatter") sovereignty to these territories,—that is, provided that the people of each should themselves decide whether the territory should come into the Union as a slave or free state. The bill was opposed by the anti-slavery leaders, for however they might differ as to what should be done with slavery where it already existed, they were all opposed to its further spread. Among these was Abraham Lincoln, who in 1858 ran against Douglas for the senatorship from Illinois, basing his campaign largely on the Kansas-Nebraska issue. The series of joint debates in which Lincoln and Douglas engaged attracted the attention of the whole country. Douglas won the prize of the senatorship, but in the debate at Freeport, Ill., he was led to declare that any territory could, by "unfriendly legislation," exclude slavery. (*See* Lincoln-Douglas Debates.)

This statement so antagonized the South that when the National Democratic Convention met in 1860 the Southern delegates "bolted" rather than support Douglas for president, and named John C. Breckinridge in a separate convention, as their candidate. The Northern Democrats nominated Douglas. The split in the party made the election of Lincoln, the Republican candidate, a foregone conclusion.

Douglas now devoted his energy to opposing secession, and loyally pledged his support to Lincoln and the Union. Unfortunately this valuable work was cut short by his death, less than two months after the beginning of the war. Douglas left a reputation as a formidable debater and resourceful political leader. Because of the contrast of his small body—being barely five feet in height—with his massive head and shoulders, he was known as "the Little Giant."

DOVER, ENGLAND. To Englishmen returning from travels on the European continent, the "chalk cliffs of Dover" have for centuries signified home. To continental nations seeking to invade England, these white cliffs are the path of conquest; for this great port on the English Channel is separated from France, at Calais, by only 21 miles. On bright days the French coast is visible across the Strait of Dover.

The city's long rôle in history is attested by its great castle towering on the cliffs 375 feet above the sea. This grim old building was used as a fortress in Norman times, and, with modifications, it is still a bulwark for the defense of these shores. Within its walls is a lighthouse dating from the Roman occupation of Britain. The city fought off the French in the naval battle of Dover (1217). In the World War of 1914–18, it was a submarine base; in 1940, during the war with Germany and Italy, it was bombarded by planes and long-range guns from the coast of German-occupied France.

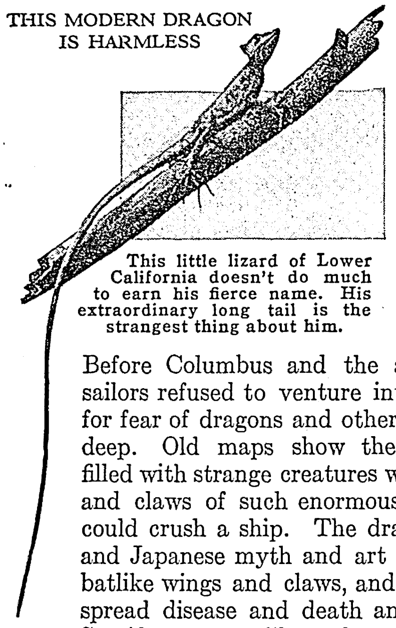
Dover lies at the mouth of the little Dour River, whose valley cuts through the chalk cliffs of the coast. The harbor, which has been improved, is one of the finest on the east coast. Normally, the city is the terminus for passenger vessels from Calais and Ostend. Shipbuilding is the city's major industry. Population, about 42,000.

DRAGON. Long ago, according to a legend of the Middle Ages, there dwelt in a distant pagan land a dreadful monster called a dragon. The flapping of its great batlike wings could be heard for miles around, and with a single blow of its terrible claws it could fell an ox. Its snakelike body was covered with slimy scales and on the tip of its pointed tail was a poisonous sting. From flaring nostrils came clouds of smoke and flame that brought death to those who breathed it.

Every year a young virgin was offered to it to prevent it from rushing upon the city and destroying all the inhabitants. One year the lot fell on Princess Sabra, daughter of the king; but she was saved by the valiant St. George, youngest and bravest of the seven champions of Christendom, who chanced to be riding in this far-off land in search of adventure. With his magic sword Ascalon, he wounded the monster so sorely that the Princess was able to put her sash about

its head and lead it, meek as any lamb, to the market-place of the town, where St. George slew it with one blow. Won over to the Christian faith by this deed of its champion, the people were baptized, and the Princess was wedded to her deliverer.

THIS MODERN DRAGON IS HARMLESS



This little lizard of Lower California doesn't do much to earn his fierce name. His extraordinary long tail is the strangest thing about him.

This is but one of the many dragon stories told in the lore of different countries (*see* Perseus; Siegfried). Before Columbus and the age of discovery sailors refused to venture into unknown seas for fear of dragons and other monsters of the deep. Old maps show the uncharted seas filled with strange creatures with wings, horns, and claws of such enormous size that they could crush a ship. The dragons of Chinese and Japanese myth and art are reptiles with batlike wings and claws, and are supposed to spread disease and death among the people. Sacrifices are still made to appease their wrath. For ages the dragon was the emblem of the former imperial house of China. That these superstitions have a basis of fact is perhaps indicated by the discovery of fossil skeletons of mammoth reptiles that roamed the prehistoric world. Although the most terrifying beasts of prehistoric times, such as the Dinosaurs, lived in the ages before man had appeared on earth, there may have been some surviving reptiles of great size in the time of the primitive cavemen of Europe. Such beasts would easily give rise to legends of monsters such as the dragons. (*See* Animals, Prehistoric.)

In the East Indies certain small lizards, seven or eight inches long, are known as "dragons." They are about the color of tree bark, and the skin along their sides between the legs spreads out into a kind of parachute, enabling them to fly among the branches of the trees in which they live. There are about 20 species, all harmless.

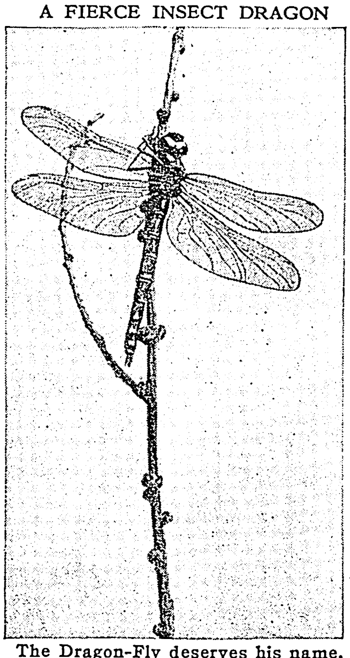
DRAGON-FLY. Some fine summer day, if you are lucky, you may see a thick clumsy-looking insect, built something like a grasshopper, crawl out of the water of a pond and wearily make its way up the stalk of a plant. Presently you will see its muddy coat split down the back; and slowly and painfully there crawls out a light and slender creature, too weak to open its wet wings. But when it has warmed itself in the sun long enough, and its wings have expanded into long delicate cobwebby structures and dried, it suddenly takes flight—and lo! one more gorgeous dragon-fly has been born. Tennyson has beautifully described this constantly repeated miracle of nature in his often-quoted lines—

Today I saw the dragon-fly
Come from the wells where he did lie.
An inner impulse rent the veil
Of his old husk; from head to tail
Came out clear plates of sapphire mail.
He dried his wings; like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew.

Ignorant people fear these quick-darting gems of the air, and have wrongly imagined that they do mischief to men and animals. They give them such names as "snake-feeders," "horse-stingers," and "devil's darning-needles," and tell children to be careful or they will sew up their ears. This is a great mistake. Dragon-flies, so far from harming men, are very useful friends to him, for they are tremendous hunters and destroy myriads of mosquitoes, flies, and other injurious insects. Dragon-flies are the terrors of the insect world. They have two marvelous compound eyes that are each really 20,000 or 25,000 tiny eyes joined to make one great organ of sight, so that they can see their prey distinctly; and they have very powerful wings that propel them through the air with the speed of an express train. So it is a very nimble or a very lucky insect that escapes if it gets into the neighborhood of a hungry dragon-fly.

There are two large groups of dragon-flies, the dragon-flies proper which keep their wings outspread when they alight—which isn't often, for they seem tireless—and the slenderer bodied damsel-flies which fold their wings down their darning-needle backs, in the shyest way, as if they didn't want to be noticed. Their name comes from the French *demoiselle*, which means "young lady." One of the damsel-flies is so gray and modest that it is called "marsh nun."

A FIERCE INSECT DRAGON

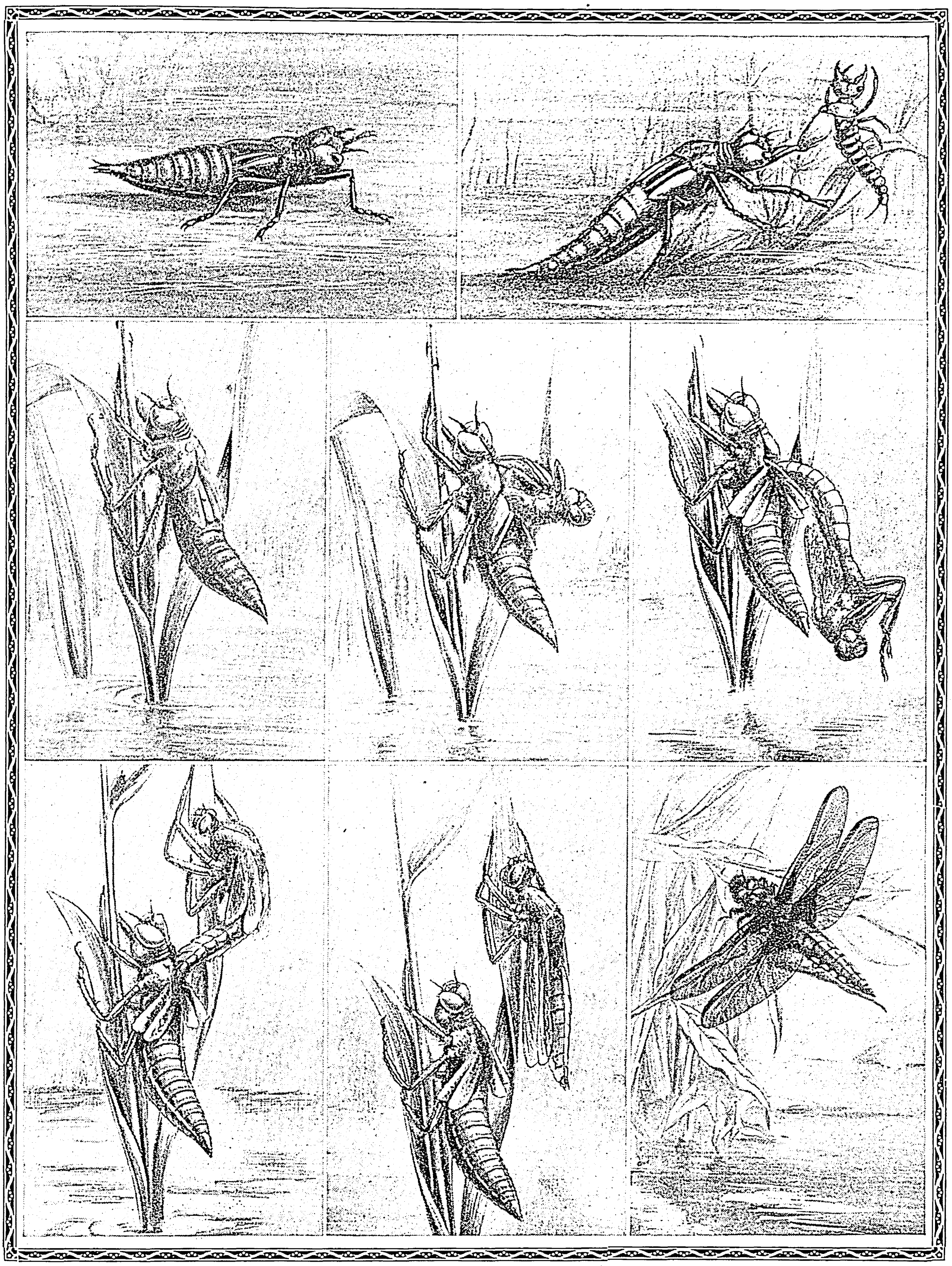


The Dragon-Fly deserves his name, for he preys hungrily on other insects.

They all have very long slender stiff bodies of dazzling colors, in steel blue, purple, green bronze, copper, and silver white. Their four long narrow silver-gauze wings are beautifully veined, and are often spotted with white or brown or amber. Their big jewel eyes stand out and glitter like lamps, and they have regular snapping-turtle mouths.

On very hot midsummer days there often seems to be nothing on the wing but these glitter-winged dragons of the air, and their swarms of little victims.

HOW THE WATER "DRAGON" GETS ITS WINGS



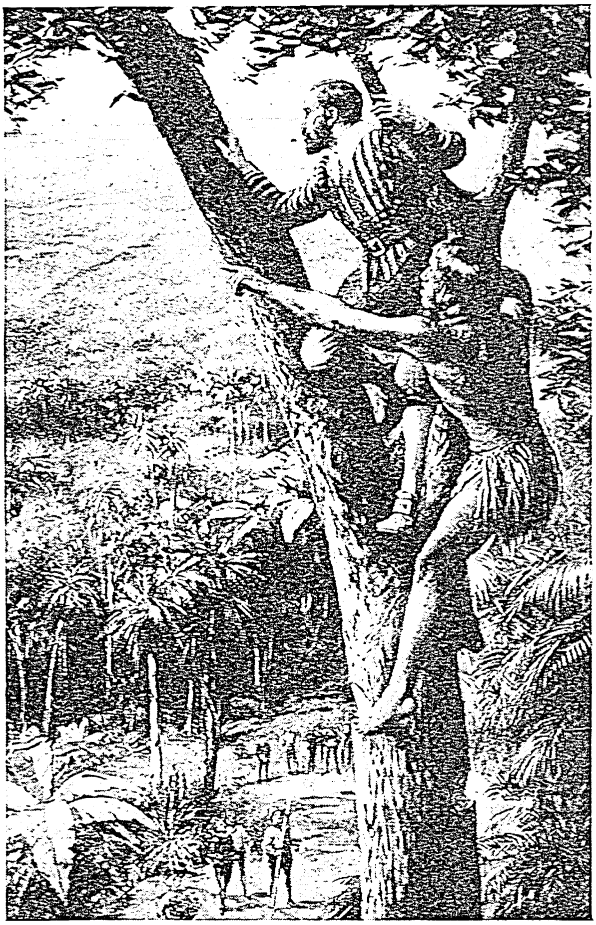
Who would suppose that the wingless creature crawling along the bottom of a pond in the upper left-hand picture was any relative of the beautiful Dragon-Fly? Yet it is a dragon-fly nymph. The picture in the upper right-hand corner shows it seizing another insect for food. When the creature has grown sufficiently, it crawls up a stem into the air, and climbs out of its old skin, as shown in the next four pictures. The next to the last picture shows it drying its wings and gathering strength, and the last shows its start in life as a full-fledged Dragon-Fly.

Some of them scurry to shelter in the water weeds if a cloud blows up, but others love to frolic with the wind, and will even go out over white-capped waves. If food is scarce on the water, some of them will go up into meadows and orchards and get a lunch of codlin moths and weevils. One species, the green-bodied damsel-fly, even ventures onto lawns, and eats house-flies and mosquitoes there.

Dragon-flies live part of their lives in the water and part on land. The eggs are laid in the water, and the young (called "nymphs") live there two or three years until they change to the adult fly. These nymphs are just as ferocious in the water as the dragon-flies are in the air. They feed upon small water insects, and even very small fish. The underlip is jointed and very long, and bears at its tip a strong pincer. With this they reach out, grasp the food, and convey it to the mouth. When not in use this lip is folded back underneath the head. They breathe by sucking water into the lower part of the body, where the oxygen is extracted by many little tubes. The water is forced out again, at the same time sending the nymph darting through the water in a series of jerks.

Dragon-flies are members of the order *Odonata*. Among the most abundant of the dragon-flies proper are the banded (*Libellula semifasciata*) and the basal (*Libellula basalis*). Common species of the damsel-flies are the green-bodied (*Lestes eurina*) and the red-spotted (*Hetaerina americana*).

WHEN DRAKE FIRST SAW THE PACIFIC



Sir Francis Drake's first glimpse of the Pacific was when he climbed a tree in which his Indian guide had cut steps for him. When he saw it, Drake prayed to God that he might "sail once in an English ship on that sea."

DRAKE, SIR FRANCIS (1540?–1596). Most celebrated of the English "sea dogs" of Elizabeth's reign, Drake was the first Englishman to sail around the globe and he took a leading part in defeating the Great Armada gathered by Spain to invade England. To his countrymen he was a hero for whose fame "the ocean sea was not sufficient room," while in the eyes of the Spanish he was a devil incarnate.

Born in Devonshire, in the west of England, Drake grew up in a sea-faring atmosphere. While still a lad he shipped as apprentice on a coasting vessel, and at the age of 20 he accompanied his cousin, the famous Sir John Hawkins, on a slaving voyage to Guinea. Two years later he commanded a ship on another voyage, in the course of which the Englishmen were attacked in the port of Vera Cruz and lost all but two of their vessels. This disaster cost Drake nearly everything he possessed and he determined to devote the remainder of his life to a relentless war against Spain and her American possessions.

Obtaining a privateering commission from Queen Elizabeth, Drake gathered a band of adventurers together and made three successful voyages to the New World. He plundered several Spanish settlements, destroyed many of their ships, and made a daring march across the Isthmus of Panama. By climbing a high tree, he there caught his first glimpse of the Pacific. His prayer that he "might navigate those waters in an English ship" was answered on his famous voyage around the world (1577–80).

On this great voyage he set out with five vessels, intending to pass through the Straits of Magellan and explore the waters he had seen from the Isthmus of Panama. When the Straits were passed, Drake's ship pushed on alone, the other vessels having either turned back or been lost. Up the coast he went, plundering the Spanish settlements in Chile and Peru, and capturing unsuspecting treasure ships bound for Panama to transship their cargoes. A Spanish captain, captured and later released, gives us this glimpse of Drake and of life aboard his ship, the *Golden Hind*, in a letter which he wrote:

"He (Drake) is about 35 years old, of small size, with a reddish beard, and is one of the greatest sailors that exist, both from his skill and his power of commanding. He has with him nine or ten gentlemen, younger sons of the leading men in England who form his council. He has, too, all possible luxuries, even to perfumes, many of which he told me were given him by the Queen. None of his gentlemen sits down

or puts on his hat in his presence without repeated permission. He dines and sups to the music of violins. He has two draughtsmen who portray the coast in its own colors, so naturally that anyone following him will have no difficulty."

Drake sailed northward and claimed the California coast in the name of his Queen. To avoid braving the outraged Spaniards by returning the way he had come, he determined to emulate Magellan and return home by making a circuit of the globe. So he crossed the Pacific and Indian oceans, sailed around the Cape of Good Hope, and reached England in November 1580, nearly three years after he had set out. (For map showing route, *see* Magellan.) The magnitude of Drake's achievement and the courage which he displayed amply merited the acclaim which greeted him. Elizabeth shared richly in the treasure he brought, and honored him by dining on board his ship and raising him to knighthood, although she knew that this would infuriate the Spanish, already roused to a white heat of rage by Drake's exploits in American waters.

In the war with Spain which soon after broke out (1585), Drake won his crowning honors. After once more carrying death and destruction to the Spanish settlements in the West Indies, he led a daring expedition into the port of Cadiz in Spain itself. Here he destroyed so many vessels that the great expedition which was being prepared for the invasion of England was delayed for a whole year. After thus "singeing the king of Spain's beard" Drake returned home in triumph. When the great Spanish Armada finally did come sailing up the English Channel (1588) Drake as vice-admiral of the English fleet played a chief part in the running fight of a week which drove off the Spaniards (*see* Armada, Spanish). During this fight Drake encountered a fine galleon commanded by Don Pedro de Valdez. So great was the terror of the Spaniards that the vessel surrendered at once, upon learning that Drake was their opponent. The circumstance was particularly interesting because Pedro de Valdez is supposed to have been one of the leading promoters of the idea of despatching the Armada and invading England.

Some eight years later, on a final expedition against the Spaniards in the West Indies, Drake was taken ill and died. Perhaps more than any other he had helped to break down the commercial and maritime supremacy of Spain, and to set England on the way to becoming Mistress of the Seas.

TWENTY-FIVE CENTURIES *of the* DRAMA

ALL children and primitive peoples love to "make believe." The small boy pretends he is a mighty hunter and acts out an elaborate pantomime of stalking and bringing down the beasts of the forest. The girl "plays house" with her dolls and dramatizes the life she sees around her. So primitive man had mimic dances and pantomimes, in which he lived over and over again the most vivid and momentous incidents of his experience. These "make believe" games and pantomimes are the raw material out of which drama is made. Though the dramatic instinct is so deeply rooted in human nature that it manifests itself in some form in every people, no matter how low in civilization, yet of all ancient peoples only the Greeks had the genius to develop these germs of drama and bring them to splendid flower. In this article we see how the drama which delights us today grew in the course of 2,500 years from its Greek beginnings.

DRAMA. Like most other primitive folk, the Greeks early in their history had feasts to celebrate the two most important events of the year, the harvest and the springtime—the time of plenty and the time of promise. At these festivals they did honor to Dionysus (Bacchus), the god of the vineyard, of trees and plants and fruitfulness. They worshiped him with song and dance and sacrifice, and gradually the wild processions and impromptu chants became more or less fixed in form. At the vintage-festival in the winter, bands of revelers marched riotously through the village chanting their rude choruses. In the intervals between the songs the leader of the procession would exchange jests and banterings with members of the company or with the leaders of rival bands. The most striking of these dialogues would be treasured in memory to be repeated the following year, until gradually they crystallized into genuine

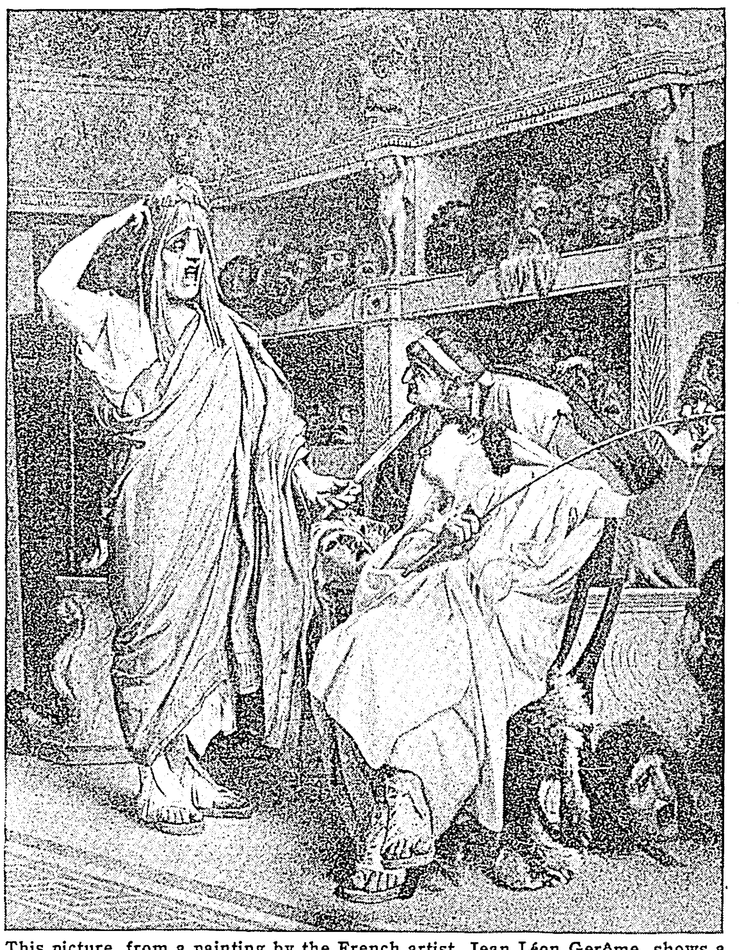
drama—the representation of a complete story by words and action. From these rude dialogues grew Greek comedy, so called from the Greek words *komos* (revel) and *ode* (song).

The Birth of Tragedy

The spring festivals took a different turn. At these times it early became the custom to tell in song and dance the chief episodes in the life of the god they were worshiping. Dressed in goat-skins to represent the satyrs—being half goat, half man, who attended Dionysus—they would dance around the smoking altar, reciting the god's adventures. From this humble beginning sprang Greek tragedy, a creation of human genius which for moral grandeur, dramatic power, and artistic perfection is equaled only by the greatest works of Shakespeare. Tragedy gets its name from the goat-skins worn by the chorus, being formed from the Greek words *tragos* (goat) and *ode* (song).

It is easy to see how in course of time the leader of the chorus would introduce passages of lively dialogue with the chorus, to amplify and explain the narrative given in the choral odes. To arrive at genuine drama, one step remained to be taken. Semi-dramatic narration must give way to actual impersonation of the god and those who shared in his adventures. This step was taken about the beginning of the 6th century B.C. by Thespis, who is traditionally known as the father of Greek tragedy. His innovation consisted in picking out a member of the chorus to play in turn the parts of all the prominent figures in the legend. This was the birth of true drama. Gradually the dialogues and choruses, at first hit off on the spur of the moment, took literary form. They were carefully worked out before the performance and committed to memory by actor and chorus.

GREEK ACTORS AND THEIR "FALSE FACES"



This picture, from a painting by the French artist, Jean Léon Gerôme, shows a group of Greek actors in the dressing room of their theater. One of them is holding before his face a tragic mask, as much as to say: "How would I do in tragedy?" Greek actors used to wear huge masks, representing the general character of the part they were playing. For comic rôles the masks were as grotesque as possible. The mouth openings were always large, to permit the voice to issue freely.

Thus the way was opened for the immortal trio—Aeschylus, Sophocles, and Euripides—who established the drama as one of the noblest forms of literary art, and left the magnificent body of plays from which have sprung all later dramatic literature worthy of the name. Each of these great men further unfolded the resources of the art.

Aeschylus introduced a second actor, thus making it possible to throw all the central incidents of a story into dramatic form. He invented a special costume for these actors, raising their stature by thick wooden soles, clothing them in rich robes, and equipping them with awe-inspiring masks, to lend to them the superhuman dignity befitting the great legendary characters they impersonated. Sophocles went a step further in introducing a third actor and giving the chorus a place of less importance. He thus heightened the dramatic interest. Euripides' great contribution was to "bring drama down from the skies." His predecessors represented the heroes, gods, and great legendary characters in more than life size. Euripides was the first realist in the drama, for he was content to paint men and women as they were, with all their defects and vices. He stripped the veil of idealism from the drama and humanized it, thus opening the way for Shakespeare and the other giants of modern drama.

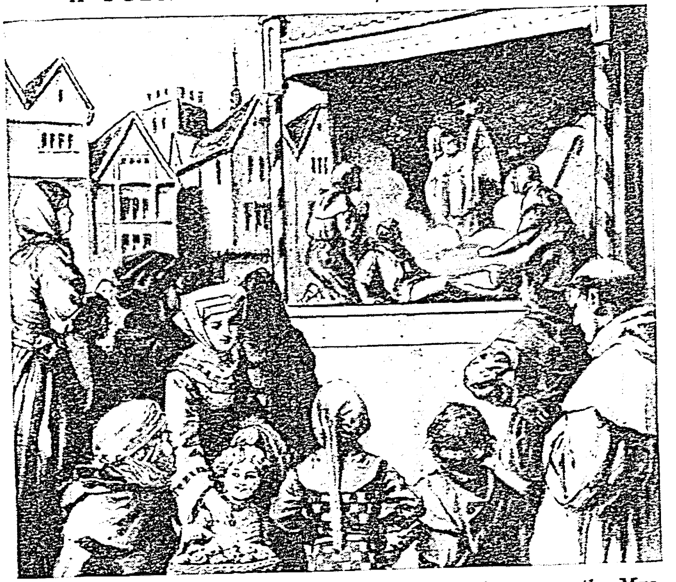
How Comedy Sprang Up

Parallel with the development of tragedy went on the growth of comedy. From the jesting dialogues of the vintage-festival grew burlesques and parodies, plentifully interspersed with broad jokes directed

against the men and fashions of the day. This is the character of Greek comedy as we see it in the plays of Aristophanes, who made it the vehicle of satires and burlesques against the Athenians of his time. Thus he ridiculed the philosopher Socrates in 'The Clouds'; and in 'The Frogs' he directed his keen-edged wit against his fellow-dramatist Euripides. Menander, the second great comic dramatist of the Greeks, whose work is known to us only in fragments and Latin adaptations, refined and elaborated the comedy form, and molded it into something like the shape we have in the modern comedy of manners.

So great were the achievements of the Greek dramatists that the Romans could only follow in their footsteps. Their chief writers of comedy, Plautus and Terence, and their one great tragic poet, Seneca, did little but imitate the Greek models. Even the scenes of Roman comedy were laid in Athens, and the characters had Greek names.

A SCENE FROM A MEDIEVAL PLAY



The great dramatic entertainments of the Middle Ages were the Mysteries and Miracle Plays, in which incidents from religious history were presented. Each group of actors had its own "pageant" or movable stage, which was wheeled from street to street while the various scenes were given over and over again until the whole series of scenes had been played at each stopping-place.

Both Plautus and Terence found their chief inspiration in Menander. Terence was content to translate or at the most adapt Menander's comedies. Plautus, aiming at a lower type of audience, dealt more freely with his originals and made his supposedly Athenian characters act and talk like the Romans of his own day. Thus he left for us invaluable pictures of "low life" in Rome.

Among the later Romans drama ran an inglorious course. The mixed populace of that time—the dregs of the vast Roman empire—had little mind to the severity of tragedy or the delicate fancy of comedy. They preferred the bloody fights of gladiators and combats with wild beasts in the arena, and the lewd buffoonery of the variety entertainment which they called the *mime*. So the influence of the rising Christian church was naturally thrown against the stage and all its works. The theater was condemned and accursed, and dramatic literature passed from view for nearly a thousand years.

Drama in the Middle Ages

Human nature, however, remained the same. Deprived of the great body of classical drama, the people of the Middle Ages began the tedious process of developing a drama all over again. There were two main lines of development. The harvest and spring time again were the inspiration of seasonal festivals, village games, and dances. The may-pole dance, which is still to be seen in rural England, is a survival of these sports on the village green.

But the chief source of inspiration was again religion, as it was in Greece. Drama was employed in the church service itself at Easter and Christmas, to bring home in concrete form the birth and the resurrection of Christ. Little plays, dialogues, and pantomimes were devised to represent these and other incidents in the life of Christ.

The new dramatic art flourished throughout Europe, but reached its greatest development in England. After a time the plays grew to such length that it was found inconvenient to include them in the regular service. Other Bible stories were added, with legends of the saints, and the performances were transferred to the churchyard and given in series. One play led to another until these "Mysteries" and "Miracle plays," as they were called, expanded to long cycles. The York Cycle includes 48 separate plays. Though the subject was always religious, the treatment often became broadly farcical, as in the celebrated scene in which Noah's wife has to be shoved into the ark.

As the plays became more elaborate the church gilds and the gild organizations of artisans assisted in the performances, and gradually took them over altogether. Each gild would make itself responsible for a particular episode and construct a float, consisting of a dressing room below and a stage above. On church festival days this float was dragged through the streets, halting at fixed points while the episode was given, over and over again, to the various companies of spectators. The costuming was often costly and realistic; devils were dressed in yellow and black to suggest the fires of hell. These Miracle plays continued to be very popular during the later 14th and throughout the 15th century. By 1550, however, their vogue had passed and they were rarely given. (*See* Miracle Plays.)

Along with these plays grew up another group—the moralities. Instead of using biblical and legendary

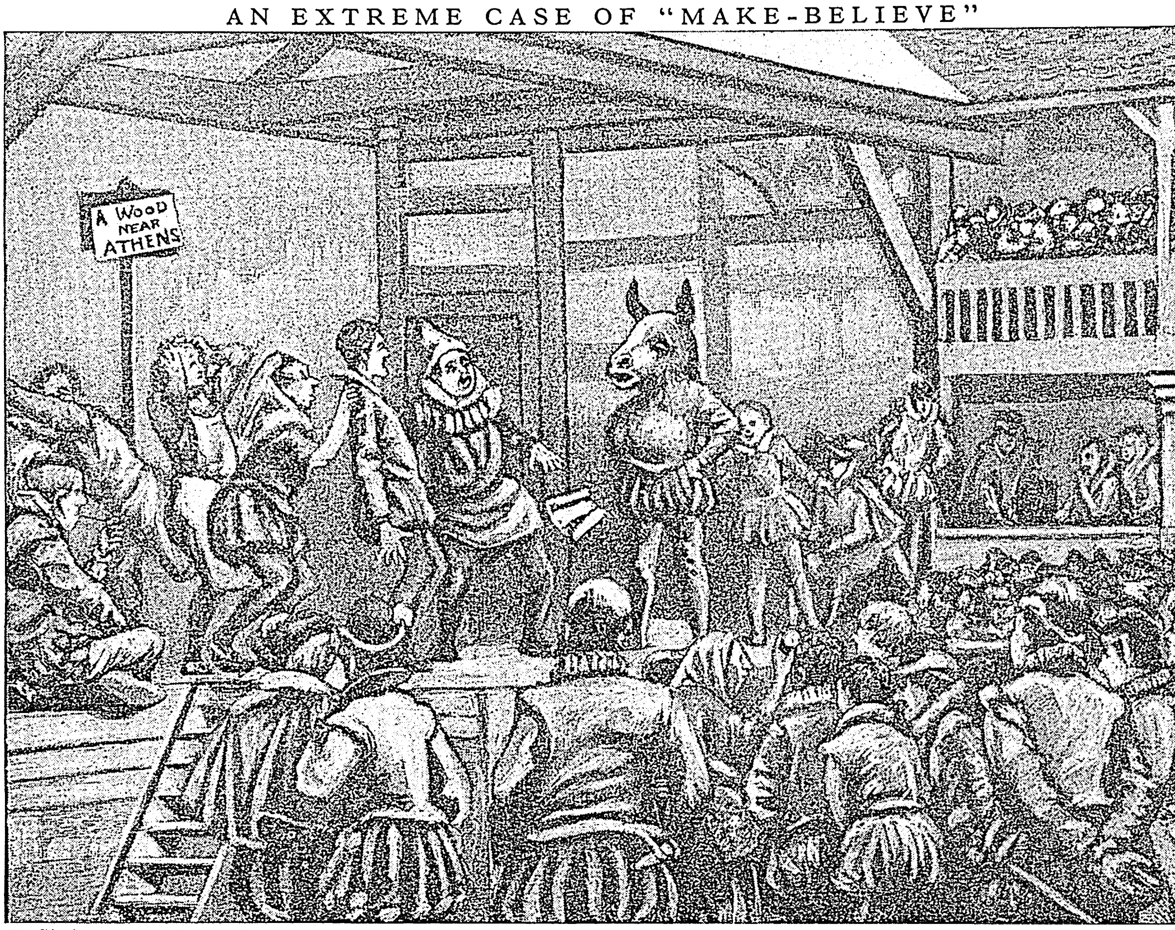
characters for heroes and villains, they personified vices and virtues such as Hypocrisy, Heresy, Piety, Justice, Peace, and Truth. One of these plays, called 'Everyman', was recently revived and put on the stage with enormous success.

Into this crude, formless, artless folk-drama the Renaissance, or rebirth of classical learning, suddenly introduced a new inspiration. In the libraries of the monasteries, which were the only considerable storehouses of learning, scholars were beginning to find the old Greek and Roman classics. The union of classical models with the subject-matter of the day produced the beginnings of modern drama.

France, England, and Spain soon developed a vigorous national drama. In Germany, which was divided into small autocratic principalities and city-states and was distracted by religious wars, national ideals were weakening through princely imitations of everything French, and there the drama developed late. Her great dramatists, Schiller and Lessing, belong to the 18th century. In England, Marlowe, Ben Jonson, and Shakespeare; in France, Corneille, Racine, and Molière; in Spain, Lope de Vega and Calderon—these are the names that will long endure.

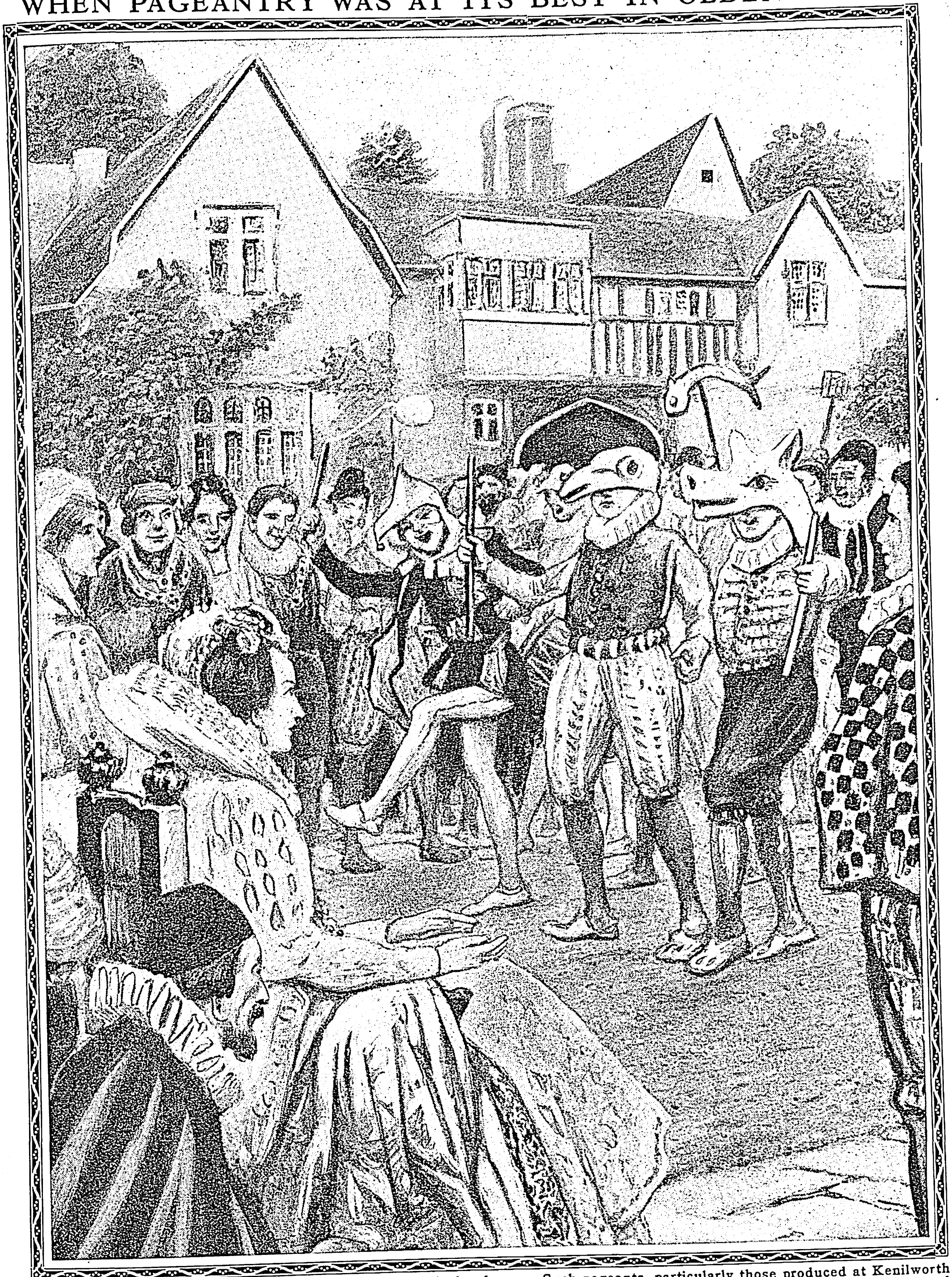
Shakespeare heads the illustrious list. He was the matchless genius, who took the best from all ages and fused it into living, breathing, dramatic art. What Shakespeare did for tragedy and romantic comedy, the great Molière did for the comedy of manners.

AN EXTREME CASE OF "MAKE-BELIEVE"



In Shakespeare's day performances were often given in the open courtyards of inns, or in rude theaters built on the same model. There was no scenery, and changes of scene were represented by sticking up placards telling where the action was supposed to take place. Here, for instance, is an amusing moment in Shakespeare's 'Midsummer Night's Dream'. It is supposed to take place in "a wood near Athens." But you would never know it, if there were not a sign to tell you so. Most of the audience had to stand during the whole performance.

After Shakespeare the English theater declined rapidly. There are many scenes of beauty and power in the plays of Beaumont and Fletcher, Massinger, Ford, Middleton, Webster, and others, but all these men fell far below their great predecessor in artistic and moral genius. In one line alone was there progress—in the comedy of manners, satirizing contemporary fads and follies. The opposition of the Puritans to the theater, already pronounced, was deepened into bitter hostility by the merciless satire which the dramatists directed against them. Finally in 1642, immediately after the outbreak of the Civil War, the Puritans closed the theaters and Parliament ordered that all stage-players be treated as rogues.



Here we see Queen Elizabeth attending a pageant given in her honor. Such pageants, particularly those produced at Kenilworth Castle, were often very splendid affairs. Here we see an amusing scene representing the animal kingdom—beasts, birds, and fish—with a clown to pass merry quips.

On the restoration of the licentious Charles II, there was a wild reaction from Puritanism to unrestrained sensuality, both in court and society and on the stage. Comic writers of genuine power, wit, and brilliance—Dryden, Congreve, Wycherley, Farquhar, Vanbrugh, and their contemporaries—poured out a flood of clever immoralities, that were brought to an end by the reawakened conscience of the people and the thunders of the famous pulpit orator, Jeremy Collier. From that day to the present the breach between the theater and the Puritan spirit has remained, though the revival of genuine literary drama in the last two generations has done much to bridge the gulf.

During the 18th century no new plays of lasting value were brought out on the English stage until the time of Sheridan and Goldsmith. Then comedy once more lifted its head, but chastened and purified. It no longer offended good taste or morals and had brilliance of dialogue as well as clever characters and situations. Goldsmith's 'She Stoops to Conquer' and Sheridan's 'The Rivals' and 'The School for Scandal' are still seen.

The 19th Century Awakening

The 19th century, which saw the great struggle for democracy, the Industrial Revolution, inventions, new ideas in science and philosophy, also witnessed, in its latter half, a real awakening of the stage.

Henrik Ibsen was the father of the new drama which reflected the changed thoughts and life of the times. His assaults on hypocrisy and his brilliant technique influenced dramatists the world over. Shaw, the Irish gadfly of the English stage, avoided the heavy-handed seriousness of Björnson and Brieux, and the murky despair of the Russians, Tolstoy, Gorky, Chekhof, and Andréef. By his jibes, entertaining and annoying in the best Irish manner, he stimulated thought rather than offered pat solutions of social woes.

The Irish did rather more than their share in the redemption of the English-speaking stage from banality through the Celtic literary revival, which centered about the Abbey Theater directed by W. B. Yeats and Lady Gregory. The "well-made play," as the French called Sardou's type of drama, carefully and tautly constructed, thrived in the hands of Pinero in England and Sudermann in Germany.

The plays of Rostand, Barrie, Maeterlinck, and several of Hauptmann's, on the other hand, turned sharply realistic portrayal to imaginative romanticism, enriched by symbolism.

Most significant for the later writers of the 20th century, however, was the growth of naturalism, launched by Strindberg, with Hauptmann outstanding among its brilliant exponents.

Naturalism arose from new conceptions of the importance of heredity and environment in the growth of character. Its heroes were passive, its scenes usually laid in the slums, its themes sordid or brutal. Many theatergoers who had observed beautiful and gay aspects of life were moved to ask what was natural about naturalism. Insofar as the word was not a misnomer, it referred to the naturalness of the lowly characters, the rough language, the background, and to the absence of a neat plot.

THE CREATOR OF "PETER PAN"

Few modern plays have had such lasting success as 'Peter Pan'. Here we see Maude Adams in the costume of the famous part.

Naturalism, and likewise the expressionistic reaction to naturalism, made less headway in France than elsewhere, since the French prefer in the theater smartly phrased discussions of manners, light love affairs, and the doings of a smoothly veneered world. Wit, fancy, sentiment, with now and then a serious touch, pervade the plays of Donnay, Sacha Guitry, Bourdet. More serious were François de Curel, Paul Hervieu, and Henri Bataille, social moralists. Conservative forms of the drama likewise prevailed in Spain, where the perfervid Echegaray, the sentimental Alvarez Quintero brothers, the Barrie-like Martinez Sierra, and the lively and versatile Benavente supplied a stage notable for its charm rather than for its novelty, ideas, or progress.

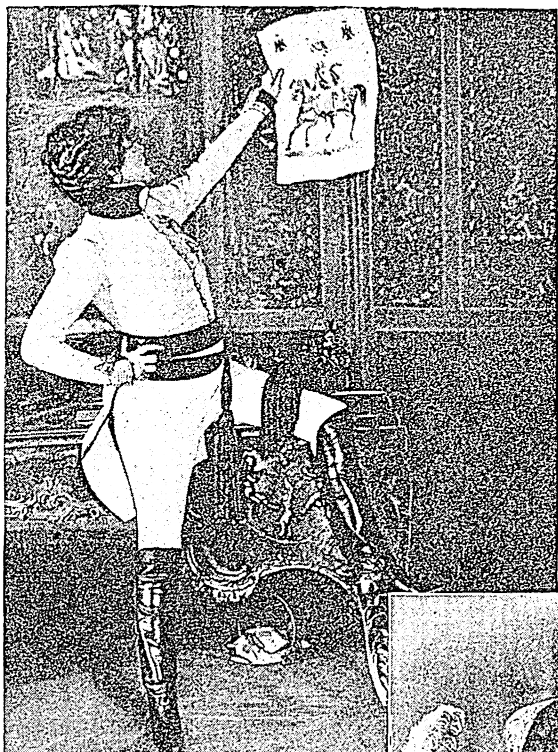
In Italy, however, the stage was enriched by many new ideas. D'Annunzio set off the fires of his colorful voluptuous art; Pirandello made the real world waver in the uncertainty of man's thoughts and dreams; Sem Benelli produced poetic, violent plays; and the poised and subtle Bracco, with faultless technique, achieved the deepest and finest realism.

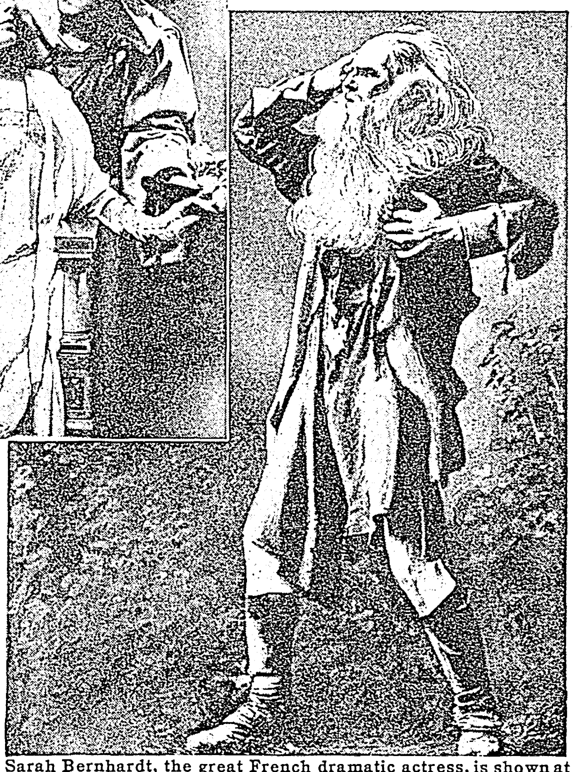
Original Experiments in Expressionism

The most original experiments, particularly with expressionism, occurred in the war-torn countries of Germany and Austria. Expressionism holds that the outside world exists only as an expression, or projection, of the world of thought and feeling within the human spirit. Galsworthy and Pirandello experimented with this principle, and Oscar Wilde had voiced it long before the term expressionism was invented. But it remained for writers in the Germanic countries to carry it out to its logical conclusion.

Among the best of the expressionists in Germany was Ernst Toller, who had been embittered by his imprisonment for taking part in a revolution in 1919. Anti-war themes and revolt against the old social order also inspired Wedekind and Hasenclever, both of expressionistic technique. More eccentric and less

FAMOUS PLAYERS IN FAMOUS RÔLES





Sarah Bernhardt, the great French dramatic actress, is shown at the top in a scene from 'L'Aiglon'. Julia Marlowe and E. H. Sothern appear in the middle in their portrayal of 'Romeo and Juliet'. Below is Joseph Jefferson after his 20-year sleep in 'Rip Van Winkle'. These players represent the romantic school of acting, trained in the 19th century.

talented were Kornfeld, Goering, and Kaiser, weavers of incomprehensible fantasies. Most famous of the expressionist plays was 'R.U.R.' by Čapek, a Czechoslovakian. The Hungarian Molnár, though chiefly known for his romantic comedies, successfully employed expressionism in 'Liliom'. Schnitzler, a witty Viennese, was conventional in technique but shocked his contemporaries because of his daring treatment of love.

Trends in the United States

The chief exponent of expressionism in the United States was Eugene O'Neill. 'The Hairy Ape', 'Strange Interlude', and many others of his plays were strikingly original in both technique and subject. Previous American dramatists such as Bronson Howard, William Gillette, James A. Herne, Clyde Fitch, Augustus Thomas, and William Vaughn Moody had treated conventional themes more or less in the European style.

But American playwrights after O'Neill dug deep into the roots of their own country for characters, language, and themes. Elmer Rice's 'Street Scene', Maxwell Anderson's 'Winterset', Clifford Odets' 'Awake and Sing', and Sidney Kingsley's 'Dead End' gave simple, realistic expression to social problems. Emphasis on the psychological rather than the social, with a lighter touch and perhaps a greater degree of technical skill, distinguished the plays of Robert Sherwood, Sidney Howard, S. N. Behrman, George S. Kaufman, and Philip Barry.

Staging the New Drama

Radical departures were made in staging, lighting, costume, and scenic decorations as directors assumed greater importance in the production of plays. Realistic scenery was supplanted by abstract settings, and by beautiful spectacular effects that suggested rather than reproduced literally.

Experiments in the new stagecraft began at the turn of the century. Gordon Craig of England and Adolphe Appia, an Italian-Swiss in Germany, were famous pioneers. Max Reinhardt's massive productions introduced rich and grandiose effects well suited to German drama. In the Moscow Art Theater modern techniques were applied by Stanislavsky, Meyerhold, and other Russian innovators.

In the United States, new theatrical ideas were readily absorbed. Lavish musical revues, in which Florenz Ziegfeld pioneered, provided one medium for the development of novel effects in staging and lighting. Among the many leaders in American stagecraft were David Belasco, Robert Edmond Jones, Lee Simonson, Norman Bel Geddes, and Orson Welles. (*See also* Theater.)

Great Names in the History of the Drama

GREEK

Aeschylus (525–456 B.C.)—'Prometheus Bound'; 'Agamemnon'; 'Choëphori'; 'Eumenides'.
Sophocles (496–406 B.C.)—'Antigone'; 'Oedipus Tyrannus'.
Euripides (480–406 B.C.)—'Alcestis'; 'Medea'; 'Bacchae'.
Aristophanes (about 448–385 B.C.)—'The Knights'; 'The Clouds'; 'The Frogs'; 'The Birds'; 'Lysistrata'.

ROMAN

Plautus (254–184 B.C.)—'Amphitruo'; 'Captivi' (The Captives); 'Aulularia' (The Pot of Gold).
Terence (about 185–159 B.C.)—'Andria'; 'Heauton Timorumenos' (The Self-Tormentor); 'Phormio'.
Seneca (3 B.C.–65 A.D.)—'Thebais'; 'Medea'.

ENGLISH

Christopher Marlowe (1564–1593)—'Tamburlaine'; 'Doctor Faustus'; 'The Jew of Malta'.
William Shakespeare (1564–1616)—'Julius Caesar'; 'Macbeth'; 'Twelfth Night'; 'The Tempest'.
Ben Jonson (1573–1637)—'Every Man in His Humour'; 'The Alchemist'; 'Volpone, or the Fox'.
Francis Beaumont (1584–1616) and John Fletcher (1579–1625)—'Philaster'; 'The Maid's Tragedy'.
John Webster (flourished about 1602–1624)—'The Duchess of Malfy'; 'The White Devil'.
Philip Massinger (1584–1640)—'A New Way to Pay Old Debts'.
John Dryden (1631–1700)—'All for Love'; 'The Spanish Friar'; 'Don Sebastian'.
Oliver Goldsmith (1728–1774)—'She Stoops to Conquer'.
Richard Brinsley Sheridan (1751–1816)—'The Rivals'; 'The School for Scandal'; 'The Critic'.
Henry Arthur Jones (1851–1929)—'Michael and His Lost Angel'; 'The Hypocrites'; 'The Liars'.
Arthur Wing Pinero (1855–1934)—'The Second Mrs. Tanqueray'; 'His House in Order'; 'Mid-Channel'.
Oscar Wilde (1856–1900)—'Lady Windermere's Fan'; 'A Woman of No Importance'; 'The Ideal Husband'.
George Bernard Shaw (1856–)—'Widowers' Houses'; 'Man and Superman'; 'Candida'; 'Pygmalion'; 'Saint Joan'; 'Back to Methuselah'; 'The Apple Cart'.
James Matthew Barrie (1860–1937)—'Peter Pan'; 'The Admirable Crichton'; 'Quality Street'.
John Galsworthy (1867–1933)—'The Silver Box'; 'Strife'; 'Justice'; 'Escape'; 'The Roof'.
H. Granville-Barker (1877–) — 'The Madras House'.
William Somerset Maugham (1874–)—'Our Betters'; 'The Circle'; 'The Constant Wife'.
St. John Greer Ervine (1883–)—'Jane Clegg'; 'The First Mrs. Fraser'.

IRISH (CELTIC LITERARY REVIVAL)

William Butler Yeats (1865–1939)—'The Land of Heart's Desire'; 'The Hour Glass'; 'Deirdre'.
John Millington Synge (1871–1909)—'Riders to the Sea'; 'The Playboy of the Western World'.
Sean O'Casey (1890–)—'Juno and the Paycock'.

AMERICAN

James A. Herne (1840–1901)—'Shore Acres'; 'Sag Harbor'.
Bronson Howard (1842–1908)—'The Henrietta'; 'Shenandoah'; 'The Young Mrs. Winthrop'; 'Aristocracy'.
David Belasco (1854–1931)—'The Girl of the Golden West'; 'The Return of Peter Grimm'.
William Gillette (1855–1937)—'Secret Service'.
Augustus Thomas (1857–1934)—'The Witching Hour'; 'Arizona'; 'As a Man Thinks'; 'The Copperhead'.
Clyde Fitch (1865–1909)—'The Climbers'; 'The Truth'; 'The Girl with the Green Eyes'; 'Beau Brummell'.
William Vaughn Moody (1869–1910)—'The Great Divide'.
Eugene Walter (1874–)—'Paid in Full'; 'The Easiest Way'.
Percy Mackaye (1875–)—'The Scarecrow'; 'Jeanne d'Arc'; 'Tomorrow'; 'This Fine-Pretty World'.
Edward Sheldon (1886–)—'Salvation Nell'; 'Romance'.
George Kelly (1887–)—'Craig's Wife'; 'The Showoff'.
Eugene O'Neill (1888–)—'Emperor Jones'; 'Anna Christie'; 'The Hairy Ape'; 'Desire under the Elms'; 'Strange Interlude'; 'Mourning Becomes Electra'.
Maxwell Anderson (1888–)—'What Price Glory?' (with Laurence Stallings); 'Both Your Houses'; 'Elizabeth the Queen'; 'Mary of Scotland'; 'Winterset'; 'High Tor.'
George S. Kaufman (1889–)—'The Royal Family', 'Stage Door', and 'Dinner at Eight' (with Edna Ferber); *see also* in this list Marc Connelly, Moss Hart.
Marc Connelly (1890–)—'A Beggar on Horseback' and 'Dulcy' (with George S. Kaufman); 'The Green Pastures'.
Sidney Howard (1891–1939)—'They Knew What They Wanted'; 'Dodsworth'; 'The Silver Cord'; 'Alien Corn'.
Elmer Rice (1892–)—'Street Scene'; 'The Adding Machine'; 'We the People'; 'American Landscape'.
Samuel N. Behrman (1893–)—'The Second Man'; 'Biography'; 'Rain from Heaven'.
Paul Eliot Green (1894–)—'In Abraham's Bosom'; 'The House of Connelly'.
Philip Barry (1896–)—'Holiday'; 'Animal Kingdom'; 'Hotel Universe'; 'Philadelphia Story'.
Robert Sherwood (1896–)—'Idiot's Delight'; 'The Petrified Forest'; 'Abe Lincoln in Illinois'.
Moss Hart (1904–)—'Merrily We Roll Along' and 'You Can't Take It with You' (with George S. Kaufman).
Lillian Hellman (1905–)—'The Children's Hour'; 'The Little Foxes'; 'Watch on the Rhine'.
Clifford Odets (1906–)—'Waiting for Lefty'; 'Awake and Sing'; 'Golden Boy'; 'Clash by Night'.

FRENCH

Pierre Corneille (1606–1684)—'Le Cid'; 'Médée'; 'Polyeucte'; 'Oedipe'; 'Le Menteur' (The Liar).
Jean Racine (1639–1699)—'Thébaïde'; 'Bérénice'; 'Phèdre'.
Molière (Jean-Baptiste Poquelin) (1622–1673)—'Tartuffe'; 'Le bourgeois Gentilhomme'.
Pierre Augustin Caron de Beaumarchais (1732–1799)—'Le Barbier de Séville'; 'Le Mariage de Figaro'.
Alexandre Dumas, the younger (1824–1895)—'La Dame aux Camélias' (The Lady of the Camellias).
Victorien Sardou (1831–1908)—'Fédora'; 'La Tosca'.
Edmond Rostand (1869–1918)—'Cyrano de Bergerac'; 'L'Aiglon'; 'Chantecler'.
Jean Richepin (1849–1926)—'Nana Sahib'; 'Le Chemineau'.
Eugène Brieux (1858–1932)—'Les Avariés'.
Maurice Donnay (1859–)—'Lysistrata'; 'Les Éclaireuses'.
Paul Claudel (1868–)—'L'Annonce faite à Marie'.
Henri René Lenormand (1882–)—'Les Ratés'.
Sacha Guitry (1885–)—'Deburau'.

GERMAN

Gotthold Ephraim Lessing (1729–1781)—'Minna von Barnhelm'; 'Nathan der Weise' (Nathan the Wise).
Johann Wolfgang Goethe (1749–1832)—'Faust'; 'Egmont'; 'Torquato Tasso'; 'Iphigenie auf Tauris'.
Johann Christoph Friedrich Schiller (1759–1805)—'Maria Stuart'; 'Wallenstein'; 'Wilhelm Tell'.
Hermann Sudermann (1857–1928)—'Die Ehre'; 'Heimat'.
Gerhart Hauptmann (1862–)—'Die Weber' (The Weavers); 'Die versunkene Glocke' (The Sunken Bell).
Frank Wedekind (1864–1918)—'The Dance of Death'.
Georg Kaiser (1878–)—'From Morn to Midnight'.
Paul Kornfeld (1889–)—'The Seduction'.
Walter Hasenclever (1890–)—'Beyond'; 'The Son'.
Ernst Toller (1893–1939)—'Massemensch'.

SCANDINAVIAN

Henrik Ibsen (1828–1906)—'The Pillars of Society'; 'A Doll's House'; 'Peer Gynt'; 'Brand'; 'Hedda Gabler'.
Björnstjerne Björnson (1832–1910)—'The Gauntlet'.
August Strindberg (1849–1912)—'Master Olof'; 'The Father'; 'Lucky Pehr'; 'To Damascus'.

SPANISH

Lope de Vega Carpio (1562–1635)—'Los cautivos de Argel'; 'El castigo sin venganza'.
Pedro Calderón de la Barca (1600–1681)—'El Mágico prodigioso'; 'La Vida es sueño'.
José Echegaray (1833–1916)— 'Mariana'; 'El gran Galeoto'.
Jacinto Benavente y Martínez (1866–)—'La Malquerida' (The Passion Flower); 'Princess Bebé'.
Serafín and Joaquín Alvarez Quintero (1871–1938 and 1873–)—'La Consulesa' (The Lady from Alfaqueque).
Gregorio Martínez Sierra (1881–)—'The Kingdom of God'; 'The Road to Happiness'.

ITALIAN

Vittorio Alfieri (1749–1803)—'Merope'; 'Virginia'; 'Saul'.
Roberto Bracco (1861–1943)—'The Little Saint'; 'Phantasms'.
Gabriele D'Annunzio (1864–1938)—'La Gioconda'; 'Francesca da Rimini'; 'La Figlia d'Jorio'.
Luigi Pirandello (1867–1936)—'Right You are if You Think You Are'; 'Six Characters in Search of an Author'.
Sem Benelli (1877–)—'The Jest'; 'The Love of Three Kings'; 'The Love Thief'.

RUSSIAN

Leo Tolstoy (1828–1910)—'The Power of Darkness'.
Anton Pavlovitch Chekhof (1860–1904)—'The Sea Gull'; 'The Cherry Orchard'; 'Uncle Vanya'.
Maxim Gorky (1868–1936)—'The Lower Depths'; 'The Children of the Sun'; 'The Barbarians'.

Leonid Andréef (1871–1919)—'Anathema'; 'King Hunger'; 'To the Stars'; 'He Who Gets Slapped'.

BELGIAN

Maurice Maeterlinck (1862–)—'Pelléas et Mélisande'; 'Monna Vanna'; 'L'Oiseau bleu' (The Blue Bird).

CZECHOSLOVAK

Karel Čapek (1890–1938)—'R.U.R.'; 'The World We Live In', written with his brother, Josef; 'The Makropoulos Secret'.

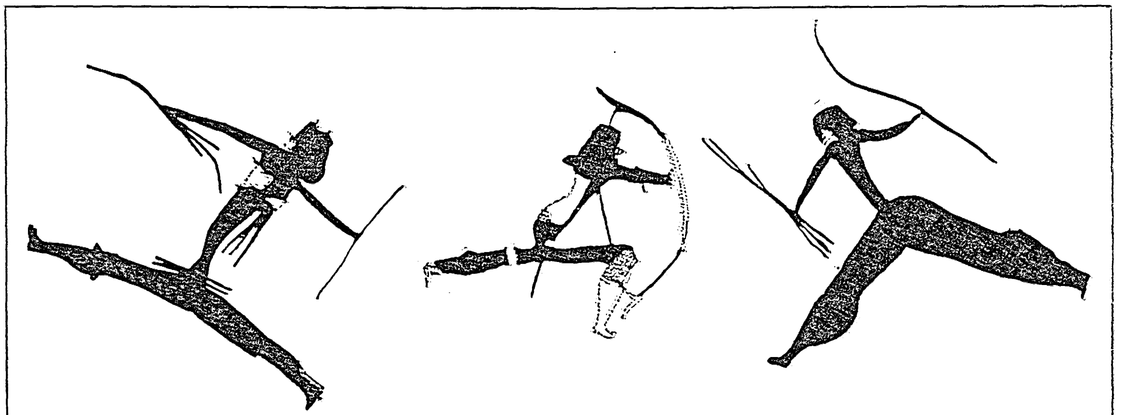
AUSTRIAN

Franz Grillparzer (1791–1872) — 'The Golden Fleece'; 'Sappho'; 'The Dream Is a Life'.
Arthur Schnitzler (1862–1931)—'Anatol'; 'The Lonely Way'; 'The Green Cockatoo'.
Franz Werfel (1890–)—'Goat Song'.

HUNGARIAN

Ferenc Molnár (1878–)—'Liliom'; 'The Swan'; 'The Devil'; 'The Guardsman'.

DRAWING—*an* ART *that was* KNOWN *in the* ICE AGE

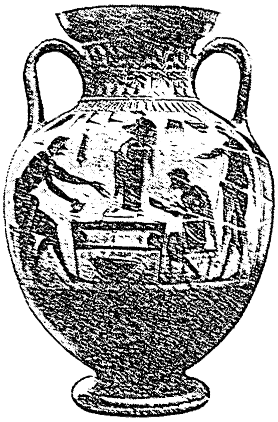


Full of life are these active hunters painted by prehistoric man of the glacial period in Spanish caves of eastern Spain. In their directness, simplicity, and vigor, these earliest of drawings remind us of the "modernist" work of today.

DRAWING. To draw a circle and then to put dots in it for eyes and a line for the mouth is among the early delights of childhood. Drawing is the first art to fascinate the young mind, and it is one of the oldest of the arts. Primitive people were remarkably skilful in drawing animals on the walls of their cave-homes. Moreover, it is the fundamental art; every other art is either based upon it or is very closely allied to it.

The word "draw" comes from the Latin word meaning "drag." So to draw is to drag a pointed instrument, such as a lead pencil, over a smooth surface, and thus leave a significant mark. The caveman no less than a great artist—a Michelangelo or a Whistler—did this. And likewise the engineer, architect, shipbuilder, or tailor makes significant marks on paper. The art of all these as well as every other art rests on drawing as a building depends on its foundation. Just what the drawing may be—a sketch, portrait, plan, or design—does not matter. They are all types of drawing. Furthermore, all writing and numbering and musical notation are kinds of drawing. We learn to write by copying letters and drawing them over and over again.

CLASSICAL BEAUTY



Masters of pure outline were the Greek vase painters. The decoration in black on this "amphora" shows the interior of a shoemaker's shop.

As drawing is generally understood, it means the pictorial records which we make of the things our eyes see and our minds imagine. Whistler drew his mother's face so that those who knew her recognized it, and we who never saw her know how she looked. Raphael drew from human faces, but made such changes as his imagination directed. All artists draw, and afterwards paint upon their drawing as upon a framework or foundation. An architect draws the building he sees in his mind's eye so that masons, carpenters, and iron-workers may know exactly how to put it up in wood, stone, and steel.

Whistler's kind of drawing, or Raphael's, or Rembrandt's, or that of artists generally, is called *free-hand;* whereas the drawing of the architect and the engineer is known as *mechanical*. It is important to distinguish clearly between them. Free-hand drawing is done without the help of mechanical contrivances, such as rule, T-square, or compass, but mechanical drawing uses them, for its purpose is not creation or suggestion, but exact information.

Free-hand drawing is done either as a preparation for painting, or as an end in itself. Drawing which is done for its own sake is the more interesting. In kind, it is the same whether done by the beginner, or by master artists, such as the Greek vase painters, or Leonardo da Vinci, Holbein, Raphael, Rembrandt, and John Sargent.

There are two distinct varieties of free-hand drawing: pure outline, and outline with shade and shadow added. The first has never been a favorite with the greatest artists. To this, the Greek vase painters are noteworthy exceptions. To see a subject in its total

mass and various "planes"—which means the three dimensions, width, height, and breadth—and differing degrees of distance, seems to be the almost universal way of master draftsmen, whether in making the slightest sketch or the finished picture. Yet the fact remains that beauty is often found in pure outline drawing. To see a good artist at work, or to understand a good drawing, is to realize that the two are never really separated in the worker's thought. Raphael kept his outline pure by not confusing it with light and shade, though he almost never drew without putting them in at an angle to his outline, but not parallel with it. Drawing of this kind may at first seem crude or even careless. However, study of it will soon show that apparent carelessness is in reality expressive of the utmost conscious intention.

A MASTER'S WORKING MODEL

Soft folds, soft bodies, with all of Raphael's grace of line and of composition, appear in this working sketch of 'The Holy Family with the Goldfinch'.

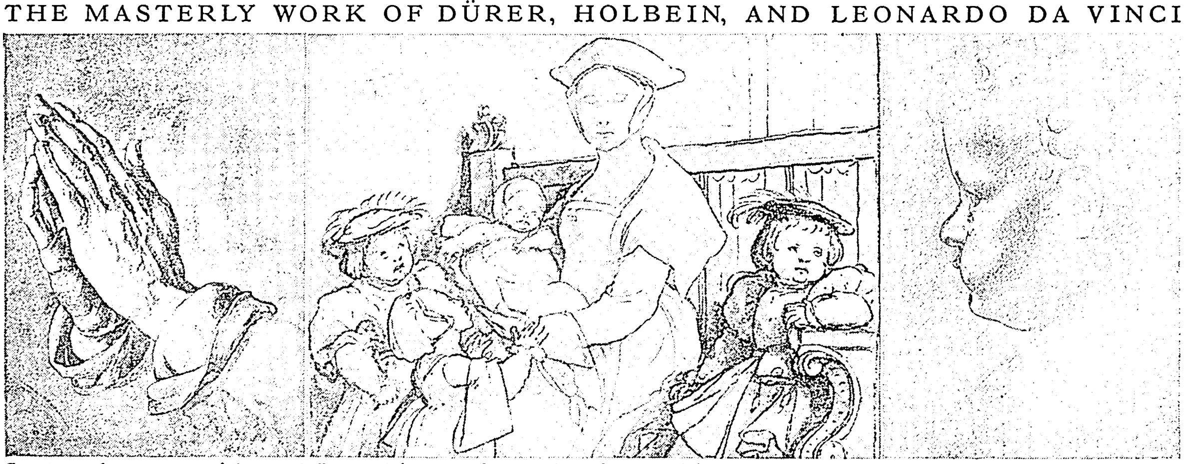
Rembrandt, on the other hand, often crossed and recrossed his light and shade lines until they made patches of lighter and darker tone. The edges fixed the shapes of the objects drawn so that there seems to be nothing in his work which resembles in the least an outline. This leads to the questions: What is a line? What is its place in drawing?

What do we really see when we look at an object, for example, an apple or a head? The answer is, only the edge where the object leaves off and its background begins. Certainly we do not see a bounding line. The flesh of the cheek, the brown of the hair, the red and yellow of the apple simply cease, and whatever is behind—the background—simply begins. The truth is that nature does not have a line in the sense in which we use the word. Man, in the infancy of the race, invented it just as he invented any other thing, such as language, for example. He felt the need to depict the shapes of things, actual or imagined. He wanted recognizable pictures. To make them he had to delimit their shapes from their backgrounds by line, which was a convention, a way, or a means universally agreed on; and in time it became "second nature" as we say.

By means of *foreshortening*, an important principle in drawing, it is easy to suggest the actual size of an object when seen from any angle. A common illustration is that of a man with arm upraised, shoulder high, pointing directly at you. A moment of careful study of such a picture will show you that the lines representing the arm and the hand are really much shorter than they would be if you saw the arm and the hand placed at right angles across the chest. And you will also observe that although there is an actual shrinkage of the lines, that is, they take up less space, yet the actual size of the arm and the hand is accurately suggested to your imagination (*see* Perspective).

Light and shade may be represented in drawing by a skilful use of lines. This process is called *chiaroscuro*, a union of two Italian words, "light" and "dark." An interesting effect of this technical feature of drawing is the impression that the object or objects are in relief, that is, certain parts seem to be higher than others; thus, the dimension of depth is suggested.

THE MASTERLY WORK OF DÜRER, HOLBEIN, AND LEONARDO DA VINCI



Greatest of engravers, Albrecht Dürer put into the famous 'Praying Hands' breath-taking technical skill and a religious feeling which has moved generations since his day. In the middle picture, you see how Hans Holbein the Younger, swift judge of character like his father, has smoothly set down with swift pencil, this interesting German family. In the sketch at the right, Leonardo da Vinci gently touched in, with his "ineffable left hand," the soft baby face. Left-handed, he always shaded his work from left to right, and wrote from right to left.

Actually, of course, a plane, or flat surface, such as a canvas or a piece of drawing paper, has only two dimensional limits, namely, breadth and height.

There is only one way to acquire appreciation of the beautiful art of drawing. Do some drawing yourself, and at all times watch nature carefully; note her facts and the moods which they create in you. Furthermore, look carefully at all sorts of drawings—newspaper cartoons, illustrations, or famous drawings or copies of them. The value of them was never better realized, or more clearly set forth than by Goethe. He said to a friend: "I have lately been able to buy many excellent drawings by celebrated masters. Such drawings are invaluable not only because they give in its purity the mental intention of the artist but because they bring vividly before us the mood of his mind at the moment of creating."

HEADS BY MICHELANGELO

Strength, movement, drama, character, are to be found in every line of Michelangelo, famed for his tempestuous energy. Each face above shows a different spirit.

If one wishes to appreciate drawing, he must learn to enjoy lines; to discover delicacy, vigor, and beauty in them quite apart from the subject which, taken together, they create. Is a line evenly thick throughout its length? Is it varied for a discernible reason? Is it crumbly to represent weathered brick or stone? Does it flow uninterruptedly to represent the muscles of a man's leg? Does it end by returning on itself like a circus-master's whip, or does it stop in a little swelling like a drop at the end of a twig? Has it attributes such as these which make it, in itself, beautiful? Can you distinguish in the drawings of famous artists the characteristic "line technique" that gives their work much of its unique distinction, its originality?

The Art of Caricature

The caricaturing of people, of animals, and of events is a special art, which usually is known as cartooning, and the comic strips and similar drawings in newspapers and magazines are called cartoons. "Animated cartoons" are produced by filming hundreds of drawings one after another, producing, when projected on a screen, the effect of an ordinary moving picture.

Caricature consists in the exaggeration of a person's characteristics, or of scenes and events, usually to make them appear ridiculous. It has proved a powerful weapon in politics. While the picture is perhaps the best form of caricature, because it is the most readily understood, the same effect can be produced by the written or spoken word. Among famous caricaturists of modern times were Sir John Tenniel of England and Thomas Nast of America. The latter broke up the powerful and notorious Tweed Ring by means of his cartoons. (*See also* Fine Arts; Painting.)

The Useful Art of Mechanical Drawing

AMONG the industrial arts taught in modern high schools, mechanical drawing is one of the most popular and useful. It is a branch of engineering drawing and, like any other form of drawing, is really a language which must be learned and used with great accuracy. It tells with straight and curved lines, to an accurate scale, the exact shape and appearance of the piece of work that is to be made from it in the shop, or that is to be erected in the field.

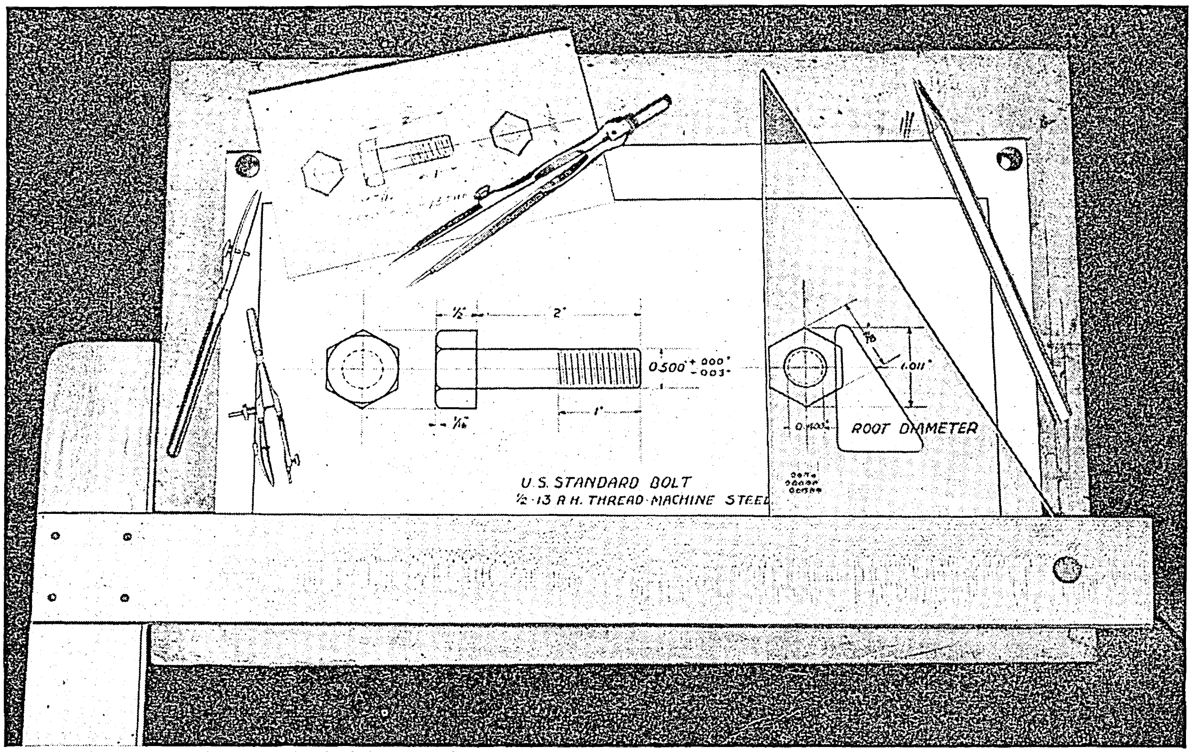
Mechanical drawing consists of several forms; and a necessary foundation for them is a knowledge of free-hand drawing as taught in grade schools, and of geometrical drawing, which may be taken up as part of mechanical drafting, or may be acquired in a junior high school. There are many geometrical constructions in engineering drawing, and knowing how to use them simplifies what would otherwise be a complicated layout. Free-hand sketching is used by the engineer or draftsman in many ways. It is one form in which notes may be kept for future reference, or a chief designer may hand a sketch to a draftsman to be developed into a finished drawing or design. Sketching is constantly used to explain ideas and show forms which would be difficult to describe in words.

Equipment necessary to begin the study of mechanical drawing includes drawing board, T-square, 45° triangle and 30°–60° triangle, set of drawing instruments, including ruling pen, pen and pencil compass, and dividers; lettering pen, pencils, drawing ink, and sandpaper pad for sharpening pencils. Drawing paper of good quality should be used, as fuzzy lines are likely to occur when ink is used on a poor grade of paper. Every draftsman should take pride in his work, and the beginner should try at all times to make his work neat and accurate.

The ruling pen must be kept always in the proper position with respect to the straight edge, so that the ruled line will have the same width throughout

its length. This can be done by resting the inner blade lightly against the edge of the T-square or triangle, with both blades parallel to the edge. The top of the pen should tip at a very slight angle to the right, and the point should not be too close to the edge of the T-square or triangle, as otherwise the ink will run under and spoil the drawing. In using the ruling pen or the pen on the compass, both points should be on the paper and the blades parallel to the direction of the line being drawn. The width of the line is controlled by a small thumb-screw through the blades of the pen.

A MECHANICAL DRAWING DONE TO SCALE, AND INSTRUMENTS



Here is shown a completed mechanical drawing, done to scale from the engineer's rough free-hand sketch at the top, together with some of the instruments used in this work. At the left, the ruling pen and bow compass for ink; at the top, the dividers; at the right, the pencil and the 30°—60° triangle with its angles of 90°, 30°, and 60°; at the bottom, the T-square. The standardized lettering explained in the article is used.

Neat lettering is an essential of the finished engineering drawing, and requires considerable practise. A standard style of lettering with large engineering organizations is a free-hand character with a 75-degree slant. Capitals, or upper case letters, and numerals are $\frac{3}{16}$ inch high, and lower case (small) letters are $\frac{1}{8}$ inch. Horizontal and inclined guide lines should be lightly drawn with pencil before the lettering is begun.

Conventions in mechanical drawing are more or less established. They consist of the different types of lines used to develop the idea to be shown, and the kind of shading used to represent different materials. Visible edges are shown by full lines, and invisible edges by dashed lines of the same width, $\frac{1}{8}$ inch long and with spaces $\frac{1}{32}$ inch long between them. Center lines are shown by fine broken lines of alternate long and short dashes, $\frac{1}{8}$ and $\frac{3}{4}$ inch respectively, with intervals of $\frac{1}{32}$ inch. In some offices the center and dimension lines are made on tracing cloth with colored ink, which produces a fainter line than black ink. Dimension lines are fine solid lines, preferably placed outside the drawing, with a break for the figures expressing the dimension. These lines have arrow-heads at the ends touching the extension lines, which are also fine solid lines. In a sectional view, the lines indicating the plane in which the section is taken are heavy broken lines consisting of $\frac{3}{4}$ inch dashes separated by two $\frac{1}{8}$ inch dashes spaced $\frac{1}{32}$ inch. It is customary to place the dimension figures so that they will read from the bottom and right-hand sides of the drawing.

Simple projections usually are made with the top view above, and the front elevation is directly below it on the same center line. To the right is given the side view revolved on its vertical axis. By this means all dimensions of the object are shown. The top view gives length and width, the front view length and height, and the side view height and width.

Working drawings are projection drawings on which are all dimensions and notes needed for the construction of the object. The number of views will depend upon how complex the object is; as many details must be given as will be required for a correct interpre-

tation of the work. These drawings have two general classifications, assembly drawings and detail drawings. In the former, the entire machine or object is shown with all its parts in their proper relation to each other. Over-all dimensions are generally given, and the different parts numbered to correspond to the same parts shown in the detail drawings. As this drawing is used in the assembly of the machine, it is customary to include on it the "bill of materials," which is a list of the standard or stock parts, such as bolts, nuts, and cotters. The detail drawings show every part of the machine with as many views as are necessary for construction. Invisible parts that cannot clearly be shown in top, front, or side views, are given in "section"; that is, the object is drawn as though the part in front of the view to be shown had been cut away. This is indicated as a section by the cut material shaded with diagonal lines. The section may be made through the object in the same plane, or in more than one plane. A broken line with a letter at each end shows where the section has been made.

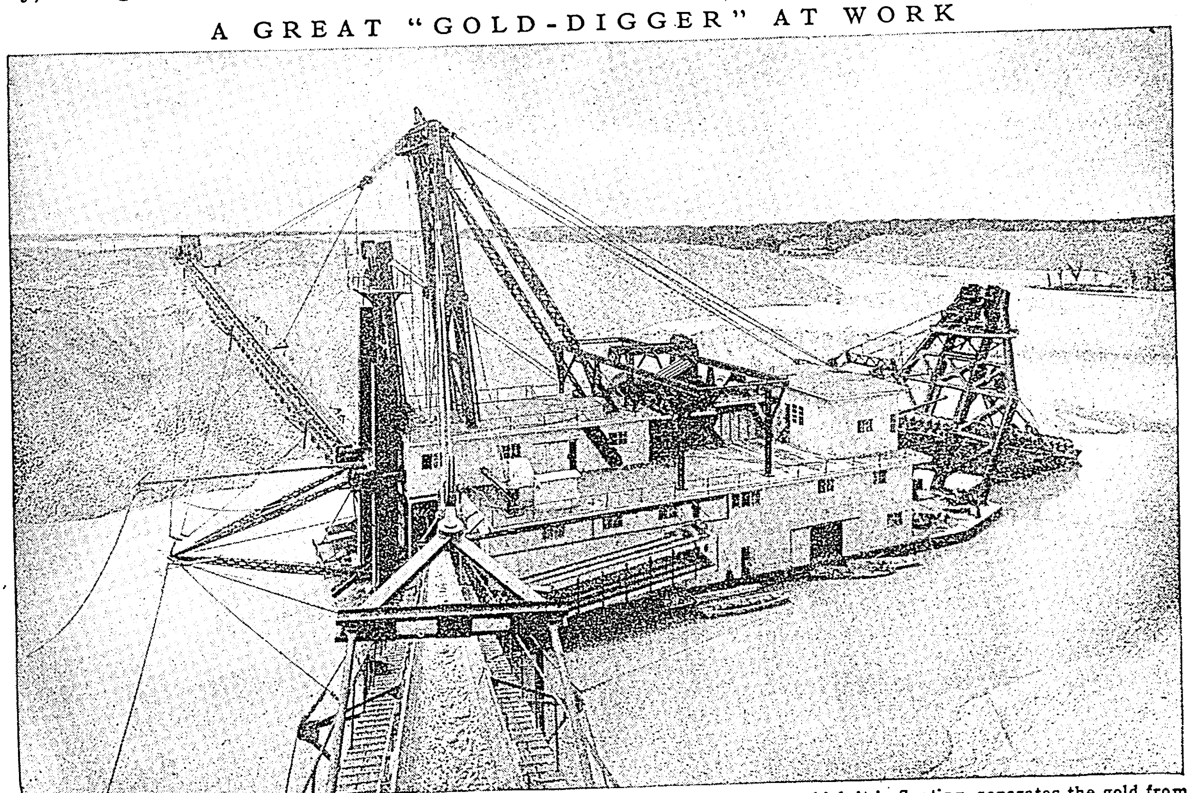
DRED SCOTT DECISION. Dred Scott was an ignorant negro slave who had belonged to an officer in the United States army. His master had been ordered from Missouri to Rock Island, Ill., and had taken Dred Scott with him into that free state. Then he had been ordered to Fort Snelling in Minnesota Terriory, and again he had taken Dred Scott, although Minnesota had been declared free territory by the Missouri Compromise of 1820. At Fort Snelling Scott had married a negro woman, and when his master was ordered back to Missouri both Dred Scott and his wife accompanied him as slaves.

After a time the master died and Dred Scott decided to try to gain his freedom. He claimed that he was free because he had lived in Illinois and Minnesota, where slavery was not allowed. The case was finally carried to the Supreme Court of the United States. In 1857 a majority of the Court, through Chief-Justice Roger B. Taney, declared that Dred Scott was still a slave. What was worse, the majority of the judges went out of their way to declare further that Congress had no power to prohibit slavery in the territories, and that the Missouri Compromise was therefore unconstitutional from the beginning.

President Buchanan urged all the people to accept this decision as final, but the anti-slavery party of the North refused. They declared that the Supreme Court had in the past changed its decisions on constitutional questions, and they continued their agitation against extending slavery in the hope of a future decision as favorable to freedom as this was to slavery. (*See* Civil War and Reconstruction.)

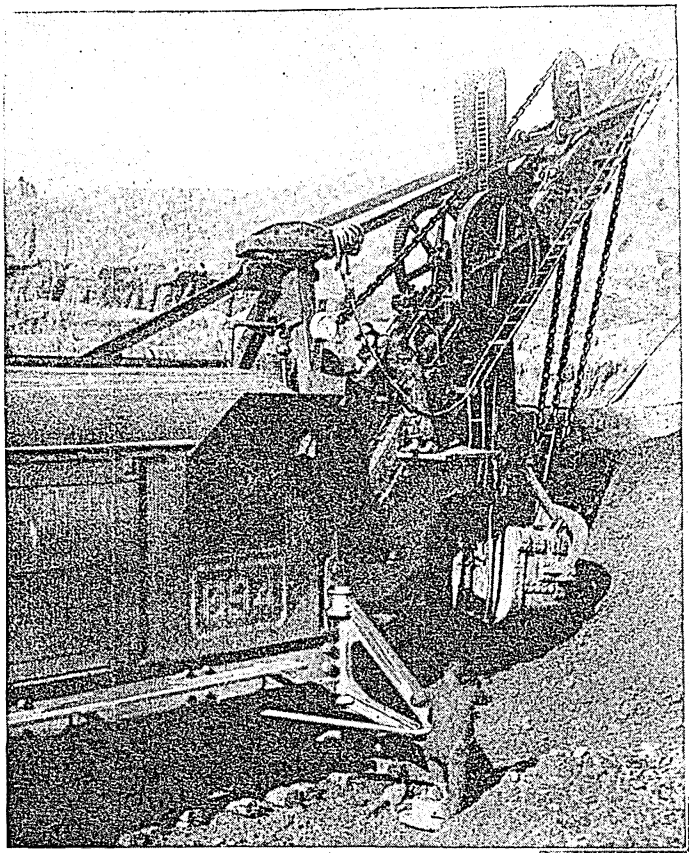
DREDGES AND STEAM SHOVELS. Dredging means, especially, excavating soils from the bottom of lakes, rivers, and other bodies of water. It is necessary in

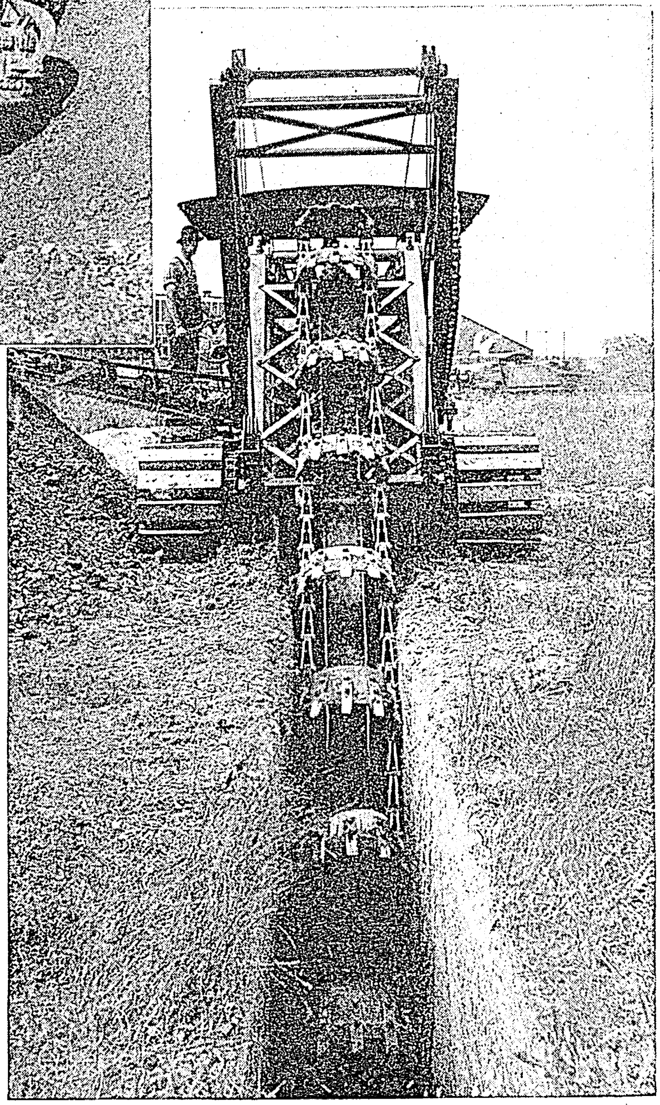
A GREAT "GOLD-DIGGER" AT WORK



This mighty dredge digs gold-bearing earth from the bottom of the California river on which it is floating, separates the gold from the mud and sand, and then carries the débris out over its two long conveyor arms or "stackers" to the bank. The chain of steel buckets which does the digging can be seen just dipping into the river.

DIGGERS WORTH MANY "PICK AND SHOVEL" GANGS





Above is a modern steam shovel, which can take in several cubic yards of earth at one "bite." Contrast this with what a mere human digger can do! And the steam shovel doesn't get tired, either. To the right is "the soldier's friend"—a ditch-digger that was used to make communication trenches and drainage ditches during the World War. In time of peace it digs sewers.

deepening, widening, or straightening river channels, in deepening harbors or bays, in building dikes and levees, and in preparing foundations for bridges, lighthouses, and the like. Diamonds and various metals, especially gold, platinum, and tin, are sometimes mined from river bottoms and alluvial soils by dredging. This work is done with powerful machines mounted on floats known as "dredges."

The most common form is the "dipper" dredge. This is the typical American dredge and is very largely used in river improvement work and in digging drainage canals. It consists of a hoisting engine with a swinging crane to which is attached a great thrusting shovel or dipper. The dipper is lowered to the bottom and drawn forward into the materials to be raised, by means of cables. Then it is raised clear of the water and swung around until it is in the desired position for emptying. The bottom of the dipper is hinged, and when a cord attached to the latch is pulled, the load falls out.

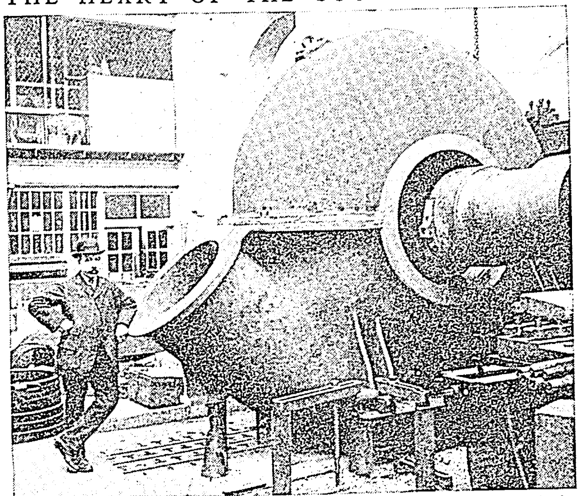
The dipper dredge can excavate all kinds of soil and can even rip through soft rock without blasting. The usual capacity of the buckets is from one-half a cubic yard to six cubic yards, although in the construction of the Panama Canal two mighty machines were used with a capacity of 15 cubic yards to each bucketful.

In the "clamshell" grapple dredge, a bucket composed of two great scoops, hinged at the top, is dropped from the end of a beam; the two halves are then closed, and the whole is raised by chains and tackle. Another grapple dredge has an "orange-peel" bucket composed of three or four triangular blades which reach down like a great hand and close over the materials to be raised. The grapple dredges are the only machines that can be operated in deep water.

Dipper and grapple dredges are known as "intermittent" dredges. The "continuous" dredges are of four types—ladder, hydraulic, stirring, and pneumatic types. The "ladder" dredge excavates by means of a series of heavy steel buckets fitted with a cutting edge, running at great speed along an endless chain or wheel. This type is used on big construction works, such as the Suez Canal, the Panama Canal, and the New York Barge Canal.

The "hydraulic" dredge removes soil by drawing it into a suction pipe and forcing it through pipelines by a large centrifugal pump. A revolving cutter loosens the soil and mixes it with water so that it will be readily sucked up. This type is especially adapted to filling in waste lands along waterways, and in the maintenance of a navigable channel in large inland waters. When operating in a river or along a shore, the water containing the dredged soil is pumped out through long pipelines and discharged over the area to be filled. The water evaporates or drains away, and the soil is left. Occasionally such dredges put out to sea and discharge the soil and water into barges from which it is pumped upon the land to be filled. This procedure was followed largely at Galveston, when the city was raised after the flood in 1900.

THE HEART OF THE SUCTION DREDGE



Here is the mighty centrifugal pump that does the work in "sand suckers" and other hydraulic dredges. Such dredges pump or "suck" up the earth mixed with water.

The "stirring" type of dredges stir up the fine mud and sand so that they will be carried away by the current of the water. Since the middle of the 14th century the Venetians have employed the stirring process for the removal of sand-bars. Stirring dredges have also been used in keeping a navigable channel open at the mouth of the Mississippi River. In "pneumatic" dredges compressed air is used to force soil mixed with water through a discharge pipe. This form of dredging has a special advantage when it is desired to force materials to a great distance or to elevate them upon the banks.

The "steam shovel" is the dry-land excavator. It is like a dipper dredge, except that it is mounted on heavy trucks instead of a float. Steam shovels are used for all kinds of work—in making railroad cuts, in digging gravel beds and clay beds, in excavating streets, trenches, ditches, and cellars. They are used in excavating the soft-ore iron of the Lake Superior region, and in the copper mines of Montana. Hand shoveling has been almost entirely superseded by this power-machine shoveling, where the amount of the work justifies the cost of installation.

DRES'DEN, GERMANY. To a traveler on the Elbe coming from Hamburg for example, the first glimpse of Dresden, capital of the former kingdom of Saxony, shows a gay and graceful city. Out of a pleasant valley rise the high tower of the Hofkirche, the great stone cupola of the Frauenkirche, and many other spires and pinnacles above copper green roofs. "The German Florence," a poet called it.

Although primarily a commercial and industrial town—because of its position at the center of a network of railways giving access to Austria, Bohemia, and all parts of Germany, and because of its river trade—yet Dresden is perhaps best known for its magnificent art treasures, libraries, and scientific collections, and for the manufacture of "Dresden china," at Meissen, a suburb. Its art gallery and museum in the Zwinger are among the finest in the world; here are Raphael's 'Sistine Madonna', Ruben's 'The Boar Hunt', Titian's 'The Tribute Money', Correggio's 'Holy Night' and 'Mary Magdelene', and hundreds of other masterpieces of the Dutch, Italian, Flemish, and modern schools. Dresden has long been famed for its music. World famous composers have directed the Hoftheatre orchestra. Here Wagner, as court orchestra leader, produced 'Tannhäuser', and here Carl Maria von Weber composed some of his greatest works, including 'Der Freischütz'.

The Georgenschloss, or royal palace, built by Duke George in 1530–35, the Prinzen Palace, the Kunstakademie, the Brüle Terrace, the Japanese Palace or Augusteum with its library of more than 500,000 volumes, and the Hoftheatre are among the city's many fine buildings. Famous also is the Grosser Garten, the pleasure-ground of Dresden, with a summer theater, zoölogical garden, the Reischel Museum, and a museum of antiquities.

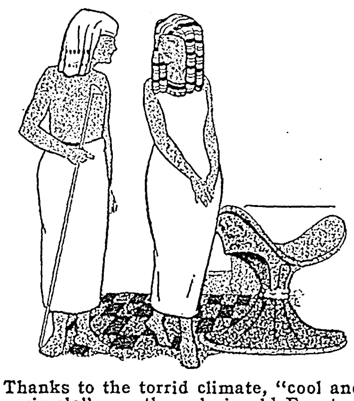
Dresden existed at least as early as 1206, and its first inhabitants were Slavic. It flourished under the kings who ruled Saxony from 1485 until 1918. The city was damaged during the Seven Years' War and again by Napoleon, whose last great victory was the Battle of Dresden in 1813. It was the scene of street fights during the German revolutions in 1919.

Dresden is situated on both sides of the Elbe River, about 111 miles south of Berlin. The Altstadt, or old city, and Friedrichstadt occupy the left bank, with the Neustadt, or new city, Antonstadt, and Alberstadt on the right bank. Neustadt was the original site of Dresden. Population, about 640,000. (*See* Saxony.)

The PAGEANT *of* DRESS *through Fifty Centuries*

The Curious and Interesting History of Styles, from the Early Egyptian Loin-Cloth to the Modes of Today

DRESS. With the spread of modern civilization, special national costumes are everywhere fast disappearing. Ready-made clothing puts man and master, maid and mistress, in the same style if not in the same fabrics. Humdrum overalls are replacing the picturesque cantonal dress of Switzerland, and the quaint Dutch national dress is rarely seen except in places where it is worn to attract tourists. Even in China and Japan, especially in the seaports, the more convenient and prosaic dress of the western countries is being adopted. The kilt of the Highland Scots has practically disappeared except as the national court dress and the uniform of the Highland regiments of the British army. The old national dress of southern Albania is similarly preserved in the uniforms of the Greek army; it, too, is a kilted affair, with flowing white sleeves, a sleeveless embroidered jacket, and a broad sash.



Thanks to the torrid climate, "cool and simple" was the rule in old Egypt.

Greek and Roman Costume

The development of costume was influenced largely by the desire to make the dress tell something of the position or rank of the wearer. In early Egypt and Babylonia, kings, priests, and other officers were distinguished by the vestments they wore over the ordinary apron or loin-cloth, which later developed into a long skirt. The draped costume reached its highest development in the dress of Greece and Rome. The garments were chiefly pieces of cloth hung in elaborate folds and fastened with girdles and brooches. The principal garment of Greece was a long sleeveless tunic of light texture (called "chiton") worn next to the skin. Over this was draped the "peplos"—a square piece of woolen cloth about a foot longer than the height of the wearer. The upper quarter was folded down, and the whole garment was then doubled and wrapped about the body, and fastened over the shoulders with brooches (called in Latin *fibulae*) of the type of our modern safety pins. This remained the dress of women, especially in the Doric states. The peplos was usually worn girdled about the waist, and in Athens it was customary to sew up the right side from below the arm. Men wore also the "himation," a square of woolen stuff similar to the peplos but draped across the chest and over one arm; and women wore the himation in different colors as an over-garment. A lighter garment was the "chlamys," a short mantle worn by young men.

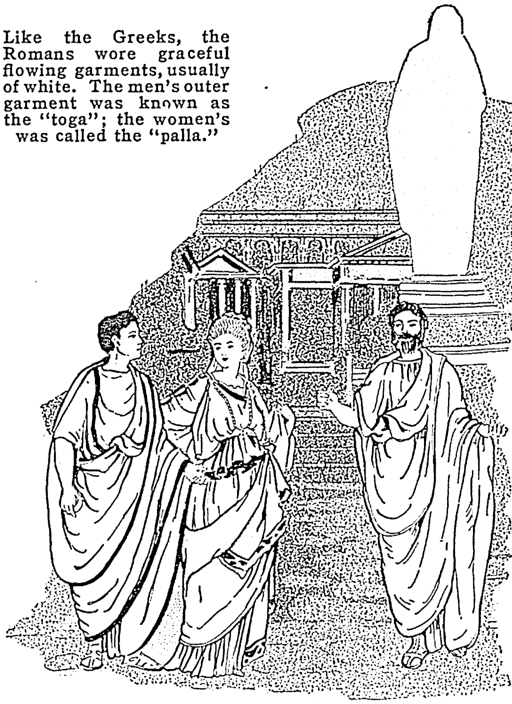
The "toga" was the national dress of Roman citizens, and was always worn outdoors, except when at work. It was a great circular piece of woolen material and corresponded, but for the difference in cut, to the Greek himation. The women wore a long tunic ("stola") with a border of darker color along the lower edge. Over this was draped a garment called a "palla," arranged in many graceful ways, according to the whim of the wearer. The toga worn by lads under 16 years of age—and also by certain officials—had a border of purple and was known as the *toga praetexta*. For special occasions, such as a general celebrating a triumph, a purple toga with embroidery was worn over a gold embroidered tunic and this became the "purple" of the emperor.

Origin of the Dress of Today

Men's clothing of today can be traced pretty plainly back to the 17th century. The long trailing garments

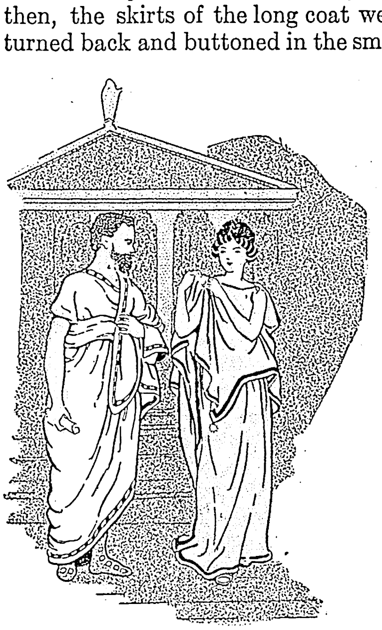
of the Middle Ages, with sleeves so long that they had to be knotted up to keep them from dragging in the mud, had passed; and so had the puffs and slashes and trunk hose, and the grotesque parti-colored clothing of Elizabethan days, which, viewed from one side, seemed to be a costume of red and white, perhaps, and from the other side, green and yellow. The doublet, the ancestor of the coat, had gradually become longer, and had buttons and buttonholes reaching its entire length, and the long loose sleeveless waistcoat showed beneath. The great petticoat breeches of the early 17th century became smaller and were fastened below the knee. Instead of the ruffs and lace collars of the earlier day, broad but plain linen collars were now worn.


In ancient Crete the women's costumes were strikingly like some 19th century European modes.


Like the Greeks, the Romans wore graceful flowing garments, usually of white. The men's outer garment was known as the "toga"; the women's was called the "palla."

For convenience in riding horseback, the ordinary method of conveyance then, the skirts of the long coat were turned back and buttoned in the small of the back, and men's frock coats still retain these (now useless) buttons. The tops of these early coats were cut so they could be fastened up around the neck, and the V-shaped nick which is in all modern coats is a survival of this custom. Gradually the coats were shortened and cut away in front. The modern evening dress represents a further such cutting away of material. When the "swallow-tail" coat was first worn, the tails reached the ground.


Frankish modes in the time of Charlemagne.

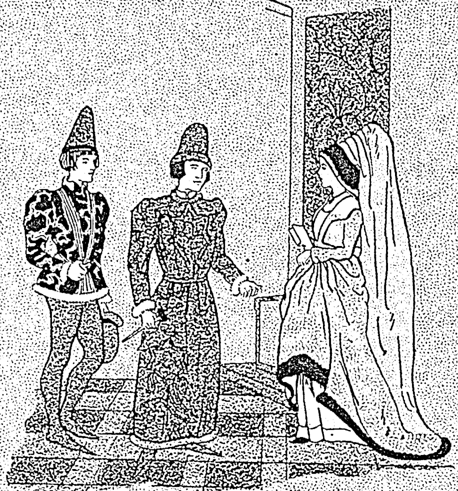

Lovers of beauty in all things, the ancient Greeks achieved perhaps the most graceful costumes known.

Wigs of various kinds have been in use since very early times. Queen Elizabeth had more than 80 wigs of different colored hair, and more than 3,000 gowns of strange fashion. As an indispensable article of gentlemen's dress the wig began in the middle of the 17th century with Charles II. The heyday of the wig came in the 18th century. The shapes it assumed were innumerable. There were wigs for clergymen and for doctors; the man of law wore a huge tie peruke, and the army and navy a great cluster of temple curls with a pigtail behind. The fashion of powdering the hair came in from France and continued through a considerable period. The wig is still worn in the English law courts and by the speaker of the House of Commons. Washington, as we know him from his pictures, wore a powdered wig.


In the early 15th century men in western Europe fancied puffed sleeves and pointed shoes.

About this time—1770—the high headdresses for women came in and found their extreme examples in

SOME QUEER COSTUMES IN TIME'S FASHION PARADE



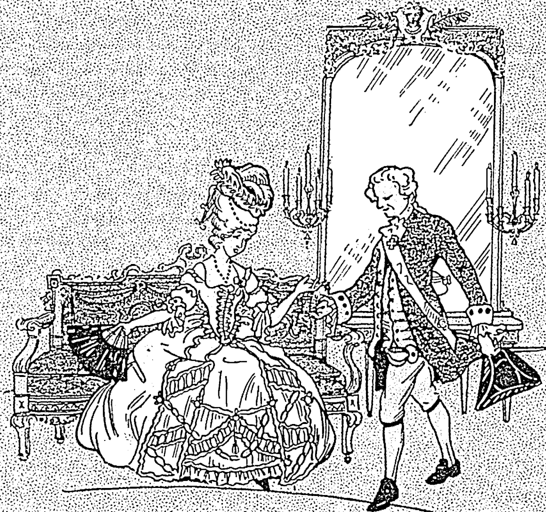
Burgundy—Late 15th Century

German—Late 16th Century (Showing Spanish Influence)

French—Early 17th Century

Dame and "Elegant" of 1695

French Sweethearts of 1760



Courtiers—Marie Antoinette Period

London fashionables in the dawn of the 19th century. The two on the right have the "latest style from Paris" and feel correspondingly superior.

France. The bodies of these enormous structures were formed of tow, over which the hair, perfumed and kneaded with pomade, was drawn in curls and rolls. The whole was freely plastered with powder, and decorated with great bows, ribbons, feathers, and flowers. Sometimes these enormous structures were surmounted by a representation of a ship in full sail, or a miniature garden, and some were so high that it was not possible to enter an ordinary door without stooping.

When our great-grandparents went walking, about the time of the Civil War, the hoop skirt for women and tight trousers and tall hats for men were all the rage.

During the French Revolution the three-cornered hat, the powdered wig, the pigtail, and knee breeches all began to go out of style and simpler fashions gradually became settled. Long trousers were first worn by the "breechesless" (*sans culotte*) rabble of the Revolution, but they soon became a part of the conventional men's dress of today. Knee breeches, however, are still worn in English court-dress and for sports wear.

Long tight trousers were the style of the early 19th century, and the dandy wore doe-skin trousers and a coat of blue, claret, buff, or brown, thrown back to reveal the waistcoat. Until near the close of the 19th century it was not fashionable to have the trousers creased, for this was the mark of store (ready-made) clothes that had lain folded on a shelf—the "hand-me-downs." With the rise of the high hat (beaver, later silk) in the 1830's, the last phase of men's fashionable costume was entered. Later styles have been modifications of the ideas launched during this period.

The great starched ruff and the farthingale are the outstanding characteristics of women's costume in the days of Queen Elizabeth. These ruffs, stiffened with wires and spread over concealed frames, became so enormous that it looked as if the head were being carried on a huge platter. The skirts became extended until they stood out at right angles to the body. This was the first appearance of that curious thing, the "hoop skirt" or "farthingale," as it was called at that time. Its next appearance was in the 18th century, when a tight-fitted bodice, often sleeveless, surmounted great billowing petticoats, and over these hoop skirts the gown was draped and looped like a drawn curtain. In 1750 the hoop petticoat had attained such proportions that ladies found it difficult to pass each other in the narrow streets of London and Paris. The last wave of the extended skirt or "crinoline" came in the 19th century. It was at its height in the United States in Civil War times, and echoes of it continued in the bustle and hip-pads even into the present century.

Near the equator, both men and women wear some modification of the skirt, while in the more strenuous life of the Arctics, both men and women wear trousers. In the great temperate zones, the men have kept the trousers and the women the skirts for the most part. The freedom of action which trousers or knickers give has led women to wear them for certain sports and for hard work in factories or on farms. (*See also* Hats and Caps; Shoes.)

How quickly styles get out of date! The "leg of mutton" sleeves and voluminous skirts of a generation ago seem almost as strange to us as those of half a century earlier.

Dressing to Suit Personality

EVERY girl or woman can be attractive in appearance if she plans her clothing according to proper principles. For clothing can be made to conceal one's defects and to emphasize one's best features.

Broad principles, rather than hard and fast rules, govern style and appropriateness in clothing. Good designers ignore many rules. Good taste demands clothing that is not peculiar and conspicuous. The well dressed person, therefore, conforms to fashion, while keeping in mind her own individual needs and characteristics.

The Question of Lines

Three basic laws of drawing and painting are generally adaptable to dress design:

1. Lines following the body contours emphasize and draw attention to the curves. If these are unlovely, this law is obviously a warning.

2. Lines opposing the body contours also emphasize the curves by making each one seem like part of a circle.

3. Lines cutting the contours lead the eye away from prominent curves and focus the interest elsewhere.

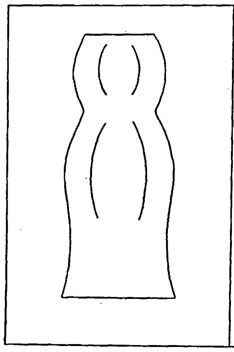


Fig. 1

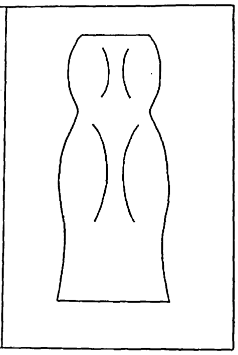


Fig. 2

The four diagrams on this page, all drawn with the same body lines, illustrate these laws. In Figs. 1 and 2, the dress is designed and fitted to demonstrate Laws 1 and 2. Notice that in both these diagrams the curves are emphasized. Figure 2 shows that the curves of hips and bust seem more prominent when each line partially completes a circle.

Lines that cut the body contours may be straight or curved. Those used in Fig. 3 are straight and severe. They carry the eye sharply past the large hip curve to an accent at the waist. The lines crossing the bust are also sharp and draw attention to a point below the curve. In this figure the waistline can afford to be the center of interest, because it is small in comparison with the bust and hips. By drawing attention to it, we produce the illusion of smaller hips and bust. In Fig. 4, the lines that cut the contour are curved. They appear more graceful than straight lines, but they produce the same effect. The curved lines at the neck of a dress may be created by seams, by folds of material, or by a necklace.

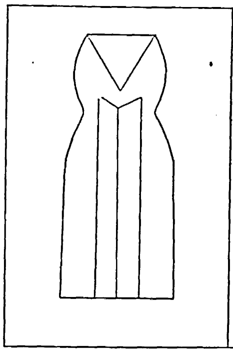


Fig. 3

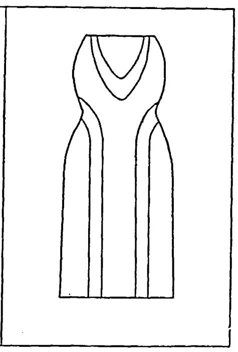


Fig. 4

Notice that in Figs. 3 and 4 the skirt falls straight from the largest part of the hips. In Figs. 1 and 2 the skirt is fitted in below the hips, making them more prominent.

Besides the three laws already given, the only infallible principles of dress design are that horizontal lines carry the eye from side to side and broaden any space, and that vertical lines carry attention up and down, lending height. We can best understand the problems involved by studying each one separately.

We may divide women into two groups, thin and fat. Thin women, tall or short, may be considered as a single group; and for them certain details of design should always emphasize the horizontal lines. The hips will be loosely fitted; and gatherings, extra panels, or pleats, as dictated by fashion, will soften the angular outline. The thin chest should never be exposed, and fashion generally takes care of this. Thin necks are helped by soft rolled collars, folds, laces, and gently rounded necklines. Lack of bust may be offset by jabots, vertical or horizontal tucks or pleats, or large bows. Thin women should never wear high, puffed sleeves, because the arm exposed below them seems longer and thinner, by contrast. If the sleeves are short, they should be plain, but long full sleeves are best.

The heavy woman, whether tall or short, presents a greater problem. Adding cloth solves problems for thin women, but to add cloth in an attempt to make a large figure appear smaller is admittedly more difficult. With Law 3 in mind, large hips may be cut by seam lines in almost any way except horizontally. Lines which carry the eye up and away from the hips are best. One narrow panel up the center front is, however, not sufficient, because it leaves a round curve on each side. In like manner, Law 3 governs the problems of the large bust; interest must be led away from the curves. Never put tight sleeves on plump, bulging arms. Use, rather, loosely fitted sleeves which draw no attention to themselves, with a definite withdrawal of the interest to another point.

Like any other too prominent curve, the *lordosis* curve (swayback) presents a problem for the dress designer. Various ways of solving the problem are: bloused backs; short jackets; dresses plain in front, with no added interest or trimming; and the use of shirring or fullness at the waistline in back.

Tightly fitted cloth always makes defects more prominent. Softly fitted material, on the other hand, can create illusions. For example, a roll collar is just as effective in disguising the too plump neck as it is

in flattering the too thin neck. When fashion demands closely fitted bodices or skirts or sleeves, individual necessities must alter the mode.

Differences in age must also be considered in providing becoming clothing for fat and thin figures. Figure 5 illustrates how simply the fat little girl should be dressed. She must have vertical lines, not horizontal, widening ones; and no added fullness or ruffles. Figure 6 illustrates the principles for the thin child. Horizontal lines are exactly what she needs; and soft fluffy hair, shirred fullness at the yoke, puff sleeves, and dainty ruffled or pleated edges fill in the scant outline.

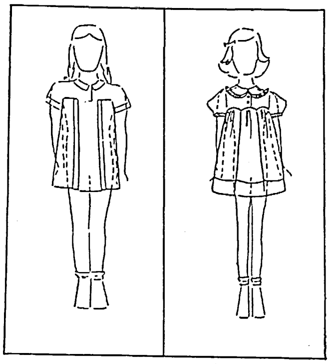


Fig. 5 Fig. 6

A girl a few years older presents additional problems. The ideal characteristics of youth are a high, small bust; slim waist and hips; soft curves of face and throat. If a girl has these advantages, plus good taste in color and a knowledge of what to wear on various occasions, she need have no worries over clothes.

Most young girls, however, do have worries; and they are caused by problems in the two basic classifications we have considered. The tall, gangling girl has prominent bones and is usually awkward. Dainty trimmings or delicate shirrings will exaggerate her angularity. She therefore needs fullness through the bust, sleeves, and skirt; or a large collar, cuffs, and belt. Large details of design will fill in the hollows, hide the boniness, and lessen her appearance of awkwardness. Figure 7 shows the tall young girl who has grown too rapidly and has become self-conscious. The slim, form-fitting dress in no way conceals her defects. Figure 8 shows the same girl flattered by her hairdress and clothes, which fill in the silhouette at the points most conspicuously thin.

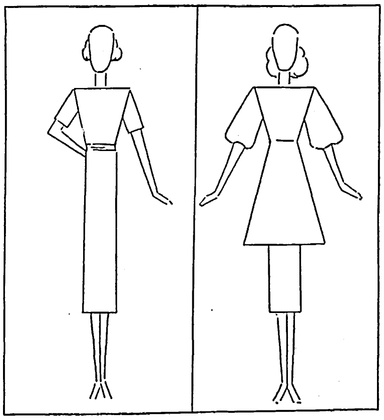


Fig. 7 Fig. 8

The plump young girl, whether short or tall, needs simplicity first, and vertical lines second. Sharp angles and straight lines will solve her difficulties. Figure 9 shows the over-plump girl, with hair fluffed about the face, and with full sleeves and strong horizontal lines at waist and hip. Her head and each horizontal section of her dress is a broad expanse. Figure 10 shows the same body, but with the girl's hair neatly arranged to lessen the apparent width of her face, and with her dress designed to produce simple vertical lines.

For the young matron or the woman of forty or more, the main consideration is to "dress her age." There is little excuse for the young matron who chooses designs with "old" lines. On the other hand, a middle-aged woman usually looks older in youthful clothes. She should choose from the smart designs specially made for women of her age. Whether she has dignity, sophistication, or motherly sweetness, the graciousness which her age connotes should be apparent in her clothes. "Ease" is the keynote, and it is gained by the use of draped lines, folds, and long subtle curves.

Fabrics and Color

To achieve personality in clothes, we must consider other matters besides the lines of garments. The most important are the colors and fabrics used. For example, fur, soft fabrics, and soft shades of color give an impression of greater luxury and delicacy than do worsteds and hard colors.

Color in relation to line is a good starting-place for study. Bright colors and large patterns of color in dress materials make the wearer seem larger. Dull colors and dark shades have a slenderizing effect. Red, white, and orange are aggressive; they come to meet the eye more than the receding colors such as black, dark blue, and dark green. A touch of an aggressive color, however, can often be used effectively as a contrast, to liven up a dull-colored dress.

It is generally recognized that colors also tend to suggest personal qualities. Red is a warm color, gay if bright red and friendly if dark. It seems naturally suited to a gay or friendly person, and to winter weather. Blue is cool. It is therefore a good summer color, or is suited especially to a cool, well-poised person.

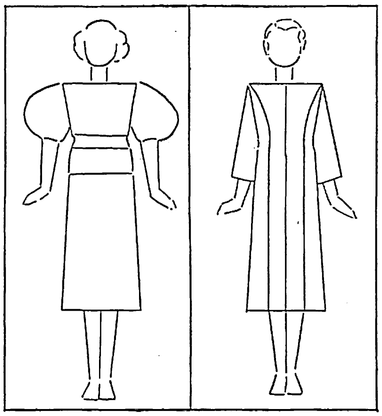


Fig. 9 Fig. 10

Light blue gives an impression of delicacy. But the darker blues, especially those which border on the blue-violet, suggest intensity and power; most women should use them sparingly. Yellow is a sunny, light-hearted young color, less sophisticated than the others. Purple is a "royal" hue, best on stately types. Green, which is a mixture of yellow and blue, is cool and youthful. Orange, a mixture of red and yellow, is the

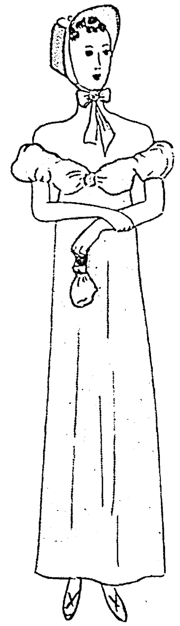


Fig. 11

warmest and brightest of all colors, unsuitable for most women to wear, except in small touches or else in fabrics which themselves draw attention away from the color, such as rich velvets or dull-finished laces.

Colors in Combination

Since colors do have such definite characteristics, one must be careful in making combinations of them. Some colors harmonize, and others do not. Inharmonious colors produce an effect comparable to a discord in music; and some of these discords, for example, the effect of blue-violet next to a certain shade of red, literally blur the beholder's vision. A combination of colors so unhappy as this drowns out the personality of the wearer. When the value of a color is altered, either by adding white to produce lighter *tints* or adding black to produce darker *shades*, the contrast of the altered color with other colors is weakened. Thus, there is much less danger of violent discords, when tints or shades are used in a design.

Each of the primary colors—red, blue, yellow—has its "complementary" color, which is a mixture of the other two (*see* Color). If we place side by side two bits of cloth in complementary colors, we find that each makes the other appear more vivid. Thus red and green intensify each other; so do blue and orange; so do yellow and purple. A neutral hue placed next to a color tends to take on a tinge of that color's complement. For example, a light gray next to red looks greenish.

Complementary colors combine most pleasingly when they are of the same value and purity—that is, with the same amount of gray or white added to dull them. In dress goods, we seldom find colors at their fullest purity, and the amount of gray in each naturally affects the way two pieces of cloth will look together.

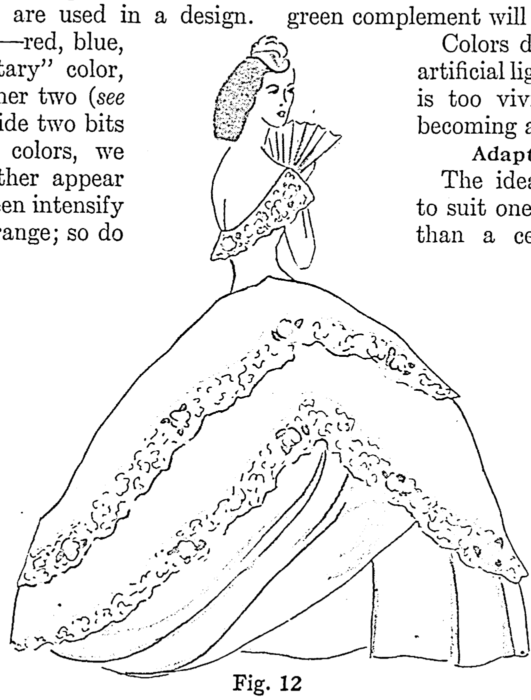


Fig. 12

Whether or not a color is becoming depends upon the color of the skin, hair, and eyes. A color that matches these features or that is complementary to them is suitable. Thus no color is likely to be equally becoming to a blonde, a redhaired girl, and a brunette. But so much depends on subtle differences of tint or shade that there can be no fixed rules.

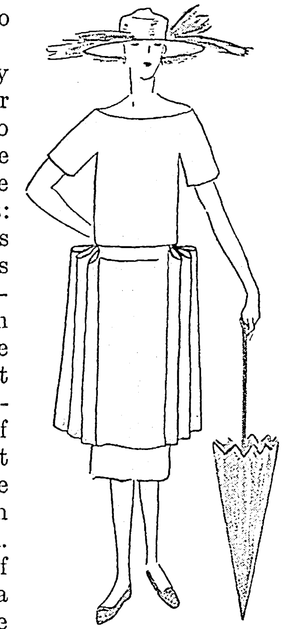


Fig. 13

Each person must try colors with one another and against the face to choose those which are best suited to her. Here are a few suggestions: Plain, dull black drains the face of color; whereas white throws color and vitality into the skin. An intense yellow gives the skin a tinge of violet which emphasizes its deficiencies, particularly if the skin is sallow. Bright yellow should therefore be worn only by a woman with a perfect complexion. To bring out the color of the eyes, one can use a large duller area of the same hue. The girl of florid complexion must be wary of pure blue near the face, for the orange complement of blue exaggerates the color of her skin. If she wears red-violet, the yellow-green complement will be flattering.

Colors differ in different lights. Most artificial lights are softening; a color which is too vivid by daylight may be very becoming at night.

Adapting Styles to Personality

The idea of modifying current styles to suit one's personality is scarcely more than a century old. In earlier days women of all ages and shapes wore the same styles. Changes in fashion were brought about to suit the individuality of queens and high ladies of the court. Everyone else followed whatever fashion the royal idiosyncrasies dictated. New modes were generally named after the historic period or after the originator, and much of their effectiveness lay in their contrast with the styles which preceded them.

An example of a style worn by all, though obviously suited only to women with perfect shoulders and well-proportioned hips, is that of the Empire period, 1804–15 (Fig. 11). Its exquisite simplicity was in startling contrast with former extravagance of fabrics and jewels, as well as with the style which followed it—the Eugénie crinoline (Fig. 12). The billowing Eugénie hoopskirt is said

to have been adapted from the farthingale style of Elizabethan days to conceal the figure of the Empress Eugénie when she was expecting a child. Thus, the whim of an Empress completely changed the style for thousands of women and girls.

As recently as the early 1920's, current fashions were often rigidly followed, whether or not they were becoming (Fig. 13). The dress hung from the shoulders like a sack, and was often further disfigured by added width at the hips. A style of this kind is not only unattractive but by its very design is rigid and incapable of adaptation to different figures.

Styles have become increasingly flexible in recent years, and any woman can find clothes easily adapted to her own needs, among the widely diversified styles of today.

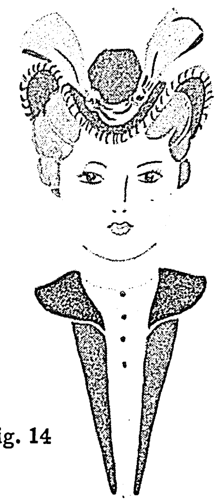


Fig. 14

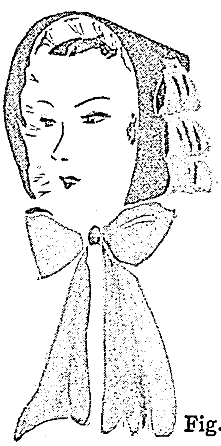


Fig. 15

Fig. 16

Fig. 17

(These and other sketches with this article were prepared by the Department of Dress Design of the Art Institute of Chicago.)

Choosing Hat Designs

Lines, color, and fabric are as important in hats as in dresses. If the lines of a hat are to do their best for the wearer's face and conceal its defects in shape, they must be chosen according to the three laws given for dress lines.

The too round face becomes less full if the hat has sharp cutting lines. The hat of 1899 (Fig. 14) is an excellent example, with all lines leading the eye up and out from the face. If you cover the hat you will notice how much fuller the features seem. The quaint bonnet of 1850, shown in Fig. 15, is excellent for the long thin face. The dainty ruffle near the face fills in the hollows; the ribbon loops on either side and the bow at the chin give width; and all the lines are therefore broadening. Figure 16 shows a perfect oval face, surmounted by an Empress Eugénie hat that would not be becoming to round, long, or heavy faces. The true oval face wears any hat well, because there are no defects to overcome. The square face is usually strong, and needs a boldly designed hat, such as that shown in Fig. 17. A hat of this kind (style of 1905) softens the too strong face and makes it seem smaller.

Styles in hats change rapidly. The hat styles of our mothers, which we laugh at today, may tomorrow again be in the height of fashion. But hats, like dresses, now have individuality, and every modern hat style leaves room for personal adaptation. To choose a becoming hat, a woman should stand before a full-length mirror and see the hat in relation to the lines of the figure and the lines and color of the costume, as well as in relation to her face. She should note the effect from both sides and from the back.

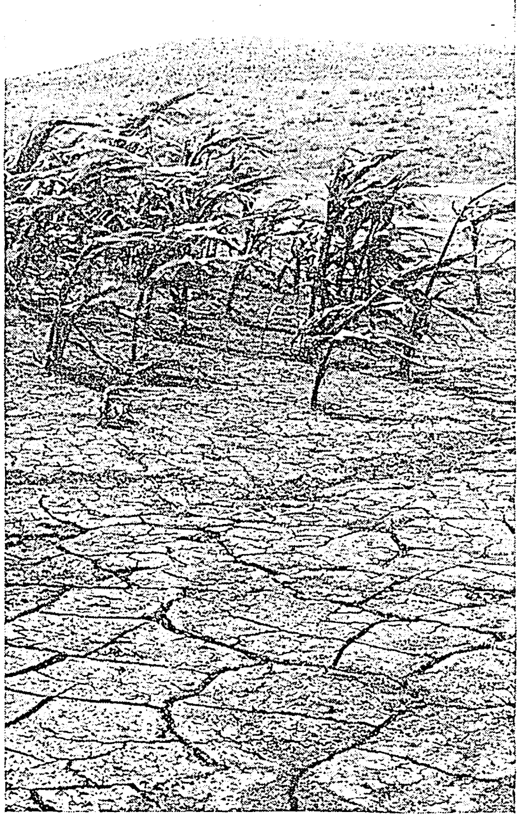
An excellent way to judge the costume as a whole is to stand in front of a strong light so that only the shadow or silhouette of the figure is shown in the full-length mirror. Silhouettes should have a general harmony of mass and line, and one strong point of interest. Next, one should stand facing the light and the mirror, to be sure that there are not too many different fabrics in the ensemble, and no conflicting types of ornament.

Jewelry should be chosen with even greater care than its background, if that is possible, for the jewelry may become an exquisite addition to a costume or may ruin the entire effect. It should be suited to, and not compete with, the dress. Since jewels, semi-precious stones, and plain metals are worn for their brilliance, luxury, and individuality, they should become the center of interest. For that reason, strikingly different pieces are often the inspiration for the dress which they set off, and expensive jewelry is usually given the background of a beautifully simple gown.

Accessories are the final test of good taste and grooming. They may become the most interesting part of the costume, or may lack special interest, as style dictates, but to the observing person they determine the success of the ensemble. A new dress may fail completely in its effect if judgment has been used too sparingly in selecting the accessories; or if shoes, stockings, bag, or gloves are not suitable for the occasion.

When DROUGHT *Scourges the* FARM LANDS

DROUGHT. Farmers count upon a certain average amount of moisture year after year. They choose their crops to fit the rainfall of their region; for example, cotton or corn for a fairly moist area, hard wheat for a drier climate. They graze cattle on land too dry for wheat. They plow and sow at different times and in different ways to meet the probable amount and time of the greatest rainfall.



The parched, cracked soil tells its own story of what drought does to the land, just as the dying corn tells of the ruin it brings to men whose living is in crops.

Every year brings farmers anxious days, unknown to most city dwellers, when they search the sky for rain clouds or for a let-up of rain. Excessive moisture brings rust, blight, and mildew to the crops or delays plowing. But the farmer most fears drought, which may shrivel his crops and kill his live stock by starvation.

Plants, animals, and men are distributed over the face of the earth in ways determined by the usual rainfall, and their welfare depends not only on a sufficient amount of rainfall, but on rain at the right season. Corn thrives best with abundant rains in July; cotton needs showers in May. Drought may plague a region even when the total rainfall for the year is large.

The variations of rainfall from place to place and from year to year used to be regarded as a hopeless puzzle. Yet scientists have lately come to believe that the variations may tend to follow some regular pattern. They hope to discover this pattern so that they will be able to foresee the probability of droughts from season to season over large areas and to take precautions against them.

Weather bureau records have not been kept long enough to be of direct help. But they serve to check the accuracy during recent years of some of the natural weather records upon which scientists must rely for more ancient information.

Clues to Droughts in the Past

The most exact natural record of weather is found in tree rings. Every year a tree adds a separate layer of wood to its trunk, inside the bark. In years of plentiful moisture these rings are thick; dry years cause thin rings. When a tree is cut down, the sequence of wet and dry years can be read backward from the outermost ring. This record first won widespread notice when it was applied to the giant sequoias of California by Ellsworth Huntington, Ernst Antevs, and A. E. Douglass. Sequoias may live to be more than 3,000 years old (*see* Sequoia); hence they afford a tree-ring record that reaches back to early historic times. For shorter spans, scientists use other trees, many of which react to weather conditions more reliably than the sequoia. Professor Douglass has carried records back in the southwest to well before the days of Columbus by means of tree rings.

Changes in the shore lines and levels of lakes also help in these studies. Goose Lake, on the boundary between California and Oregon, provides an interesting example of such changes in recent times. Pioneers, on their way to find gold in California in 1849, wore great ruts along the edge of this lake. Then for half a century wetter weather caused the lake to rise and cover the tracks until they were almost forgotten. During the droughts of the 1930's, however, the lake level fell again, exposing these old tracks.

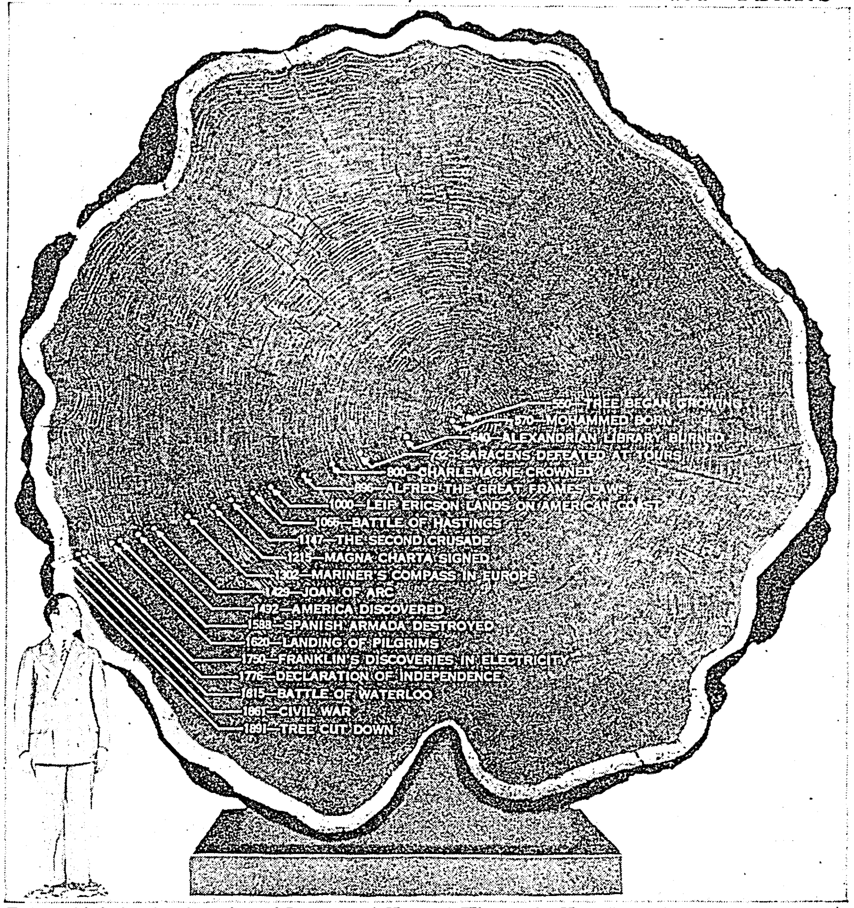
Owens Lake in California is salty because it has no outlet, and receives salt brought in by rivers year after year. But scientists compute that it has gained all the salt it contains in not more than 2,000 years. Hence 2,000 years ago the lake must have had an outlet. The only outlet to be seen in the surrounding mountains is 100 feet above the present lake level; so rainfall must have been great enough in that region 2,000 years ago to maintain the lake at that level.

In early times a wall was built near the Caspian Sea to keep out nomad invaders from Asia. History records many occasions since then when the wall was submerged by the sea, and others when it stood far above the sea. This too is evidence of changing rainfall.

The bottoms of many lakes have been filled with silt, a new layer being added each year after the period of high water. In wet years, these layers, called *varves*, are thicker than when formed in dry years. Thus, like tree rings, varves record rainfall.

Palmyra, in the present Syrian Desert, has scarcely 1,500 inhabitants; but in ancient times it was a gar-

THIS TREE TELLS OF 1,441 WET AND DRY YEARS



This exhibit in the American Museum of Natural History in New York City shows how tree rings keep a record of climatic conditions through the centuries. It is a section cut from a sequoia named Mark Twain, which was felled in 1891. It shows a growth ring for every year of the tree's life. The varying thicknesses of these rings tell the story of drought or good rainfall in California as the tree lived on through history since before the days of Mohammed.

den city which is estimated to have had a population of 150,000. Only a great change in rainfall could have caused such a loss of population. In Yucatan and Guatemala, on the other hand, we find the ruins of a Mayan civilization in a region now so damp that it is almost uninhabitable.

Lake dwellers once built their homes on stilts rising out of the Swiss Lakes. (For pictures, *see* article on Man.) When the water rose or fell, new houses had to be built. Whole series of such houses have been found by archeologists, some high, built in wet times, and others low, built in dry times.

Drought Periods and Migrations

All this evidence, taken together, convinces scientists that wet years come in groups, followed by groups of dry years. These changes are called *cycles*, and if only they came regularly, we could forecast wet and dry years accurately. So far no regularity in these cycles has been established. The only rule observed is that droughts usually extend over a number of years, growing gradually worse in the first years and then subsiding gradually. Scientists might be able to forecast wet and dry years if they knew what causes such changes. This problem is being studied intensively, but only the beginnings of success have been won (*see* Climate).

On many occasions throughout historic times, great hordes of nomadic peoples have come out of Asia to attack and destroy farming communities settled in moister lands. We feel reasonably sure that such movements must have been the result of droughts in Asia, which forced the herdsmen to move (*see* Migration of Peoples). But the population of thickly settled countries like India and China cannot migrate when drought strikes. Under such circumstances millions of people may starve to death.

Drought afflicts some part of the United States almost every year. But the country is so large that drought in one region has been balanced by good crops elsewhere, and a true famine never has followed.

The American Drought Belt

Most of the United States either has adequate moisture or is so dry that agriculture without irrigation is impossible. Between the Rocky Mountains and the Missouri River, however, lies a belt of land which sometimes receives moisture enough for farming, and sometimes receives scarcely any rain at all. The land is level or rolling, with no trees or boulders to hinder plowing. In favorable years short grass flourishes; and during many past centuries this grass has made the soil fertile with humus from its decaying roots. Early settlers were tempted by these prairies and took up homestead farms there.

Then in the 80's and 90's great droughts came, lasting many years. Corn, wheat, cotton, and grass alike withered. Cattle died, farmers moved elsewhere.

But wet years came again. Crop prices rose as city population grew. New settlers took up the abandoned farms and pushed ever farther into the danger zone of insufficient rainfall. This time they were better equipped with methods of *dry farming*. They had varieties of corn, wheat, and cotton able to withstand drought to some extent. Machinery dug deeper wells; new types of harrows pulverized the soil after each rain so that the moisture would sink in instead of

evaporating. Even during the droughts which occurred in the World War period, high prices gave dry farmers a good living.

Beginning about 1930, however, a new dry period set in, this time accompanied by low depression prices. In 1934 the whole Great Plains area, together with many other parts of the United States, faced complete crop failure. Crop damage totaled as much as 5 billion dollars. In 1936, drought struck again, with even more disastrous results. In one state, three-fourths of the population needed government relief.

Everyone Suffers When Drought Comes

The great droughts of 1932 and 1934 found the United States with a large surplus of food stocks raised in earlier years. These carry-overs saved the country from food shortage. But for years the carry-overs had been depressing farm prices, thereby impoverishing farmers and lessening their ability to withstand drought losses. When the drought of 1936 came, the carry-overs had been reduced to normal and food prices rose sharply; but the rise did not benefit drought-stricken farmers who had nothing to sell.

Higher food prices worked injury upon city dwellers. They were hurt also because impoverished farmers could not buy city-manufactured goods. Thus everybody loses when drought strikes.

How Drought Hurts the Land

The greatest injury is done to the land itself. Lands subject to drought usually have a natural cover of grass alone. Trees do not thrive there. The grassy carpet acts as a natural protection against some of the evil effects of drought. Even though the grass may be dying from drought, the roots hold together for some time and protect the topsoil from being washed away by rain or blown away by wind. When the moisture comes again, the roots usually revive, or dormant seeds sprout, and the grassy blanket is soon restored.

But when the plow has removed the natural blanket of grass from the prairie, drought may strike a deadly blow. Dry-farming methods reduce the topsoil to a powdery fineness. When dry, it is easily blown away by the wind. At first sheets of it are peeled off; then, along lines where the winds are strongest, gully-like *blowouts* may develop. If this wind erosion continues, it strips the land down to barren clay and ruins it as farming land for years to come.

In the two drought years of 1934 and 1936, thousands of square miles of rich farm land and pasture were thus stripped of rich earth. On a single day, May 11, 1934, western wheat fields are said to have lost 300 million tons of topsoil by wind erosion. The region from the Panhandle of Texas north to the Dakotas was nicknamed "America's dust-bowl." Winds carried the dust thousands of miles eastward; some of it reached the Atlantic Ocean.

This wind-driven topsoil may become heaped up elsewhere and compacted into firm deposits, called *loess*. Loess makes excellent soil wherever formed. But usually the dust is spread too finely to benefit other land, and much of it is carried by wind and streams to the ocean, where it is lost forever to the land. Meanwhile, if the subsoil is sandy at the site of the damage, the wind may set in motion great heaps of it, called dunes. Such rolling dunes may bury good soil or even farm buildings (*see* Sand).

Grazing land may be ruined by drought in much the same way. If a stockman tries to feed too many animals on his land or to feed the usual number in a year of deficient moisture, the excessive grazing destroys the tender new shoots of grass, and eventually the roots as well. Then wind erosion can start its harmful work.

When rainfall comes again, it increases the damage. The coverless land cannot resist the wash of water that drains toward the streams. The topsoil is undermined in sheets (*sheet erosion*), and soon gully erosion, along lines of the greatest drainage, cuts the land and makes plowing impossible. (For picture, *see* Conservation.)

Droughts also cause enduring injury by lowering the level of the underground water supply, called the *water table*. Under normal conditions, the water table is near enough the surface so that plants having long tap-roots can draw upon it. Other plants can obtain moisture from a higher level of soil, which is kept moist by rain and by capillary attraction of water from the water table. But when rain does not come, the water table sinks, the soil above it becomes completely dry, and plants lose their last chance of getting water. Also, as the water table falls, wells go dry, navigation and city water supply dependent upon streams suffer from lowering of water in the streams, and sewage disposal in streams becomes difficult.

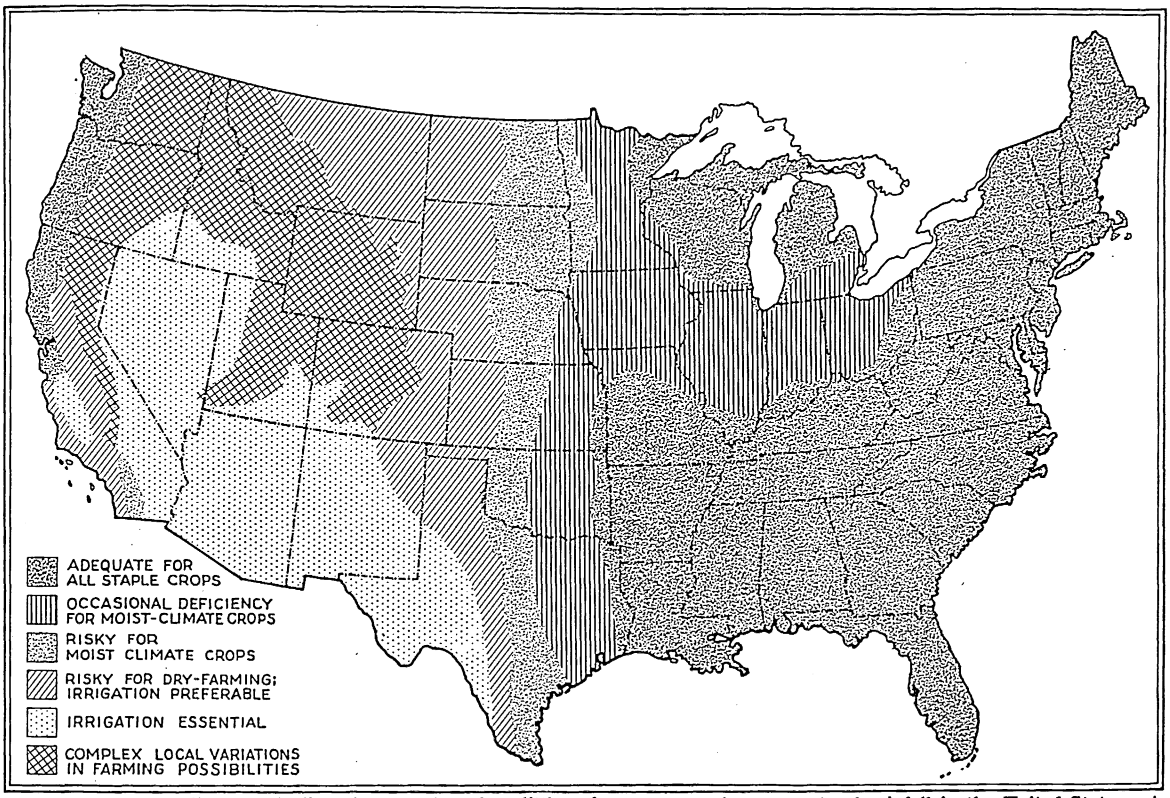
Government Measures to Combat Drought

Ever since the Far West was settled, the government has been more or less active in fighting losses due to drought. One of its earliest measures was finding drought-resistant food plants which could be grown with reasonable safety in regions where rainfall might be deficient. Expeditions went as far as the great dry plateaus of Tibet to find such plants. Kanred and durum wheat are among the results of the search (*see* Wheat).

Persistent efforts were made to train farmers in wise use of land in areas subject to drought. Wind and water erosion can be held in check by plowing, or *listing* with a combined disk and plow, in such fashion as to leave good furrows on the ground, instead of disking the surface to a powdery fineness. The furrows catch soil as it starts to blow, and also catch surface water, especially if the furrows on sloping land are plowed horizontally, so that each furrow is level throughout its whole length and lies squarely across the path of the water as it starts to drain downhill. This is called *contour plowing*.

Farmers were urged not to undertake too ambitious programs, or to contract debts which could only be paid off by getting continuously good crops. Unfor-

SAFE AREAS AND DROUGHT AREAS IN THE UNITED STATES



This map shows by different shadings how much or how little a farmer may rely upon natural rainfall in the United States. A farmer may suffer from drought, however, anywhere except in the belts of adequate moisture, if he has mistakenly tried to grow crops which require average or better than average rainfall for the section. Thus, corn planting is a hazard in the region marked "Risky for Moist-Climate Crops"; but drought-resisting hard wheat is a relatively safe crop. In the belt marked "Complex Local Variations," there are many local climate differences, caused by mountain ranges, in areas too small to be shown on the map.

tunately, the government during the World War urged farmers to grow wheat in the drought zone. After the war, the farmers remained and tried to make a living on land fit for cultivation only at wartime prices or with the help of unusually favorable weather.

The government's preventive measures and the farmers' precautions did not come in time to prevent distress in the droughts of the 1930's. In those years, the government devoted most of its efforts to measures intended to lessen immediate hardship.

Emergency Relief and Permanent Policies

Loans were made to farmers who were in temporary difficulty to help them maintain their live stock and to plant crops the following year. Live stock was bought and slaughtered for relief use or shipped to greener pastures. The necessary minimum of feed for live stock was shipped into stricken areas.

Farmers hopelessly in debt were given direct relief or work relief. Much of the work relief consisted of building dams to stop erosion and to conserve ground water, creating artificial lakes to increase the available water supply, planting trees, digging wells, and arranging supplementary irrigation canals (*see* Irrigation and Reclamation).

As part of the program for the future, farmers on *submarginal* farms, or farms which even in good years did not return a profit, were helped to find better locations. The abandoned farms were returned to grass for grazing, planted with trees, or turned into wild life refuges (*see* Conservation). All these measures were part of a broad program to restore conditions that would protect the land from the related ravages of drought, flood, and erosion—ravages which might, if left unchecked, destroy in time the fertility of America's great farming regions.

Much of the western spring wheat land, hardest hit by drought, is in wet years as rich as any land in the world. Yields of as high as 60 bushels to the acre alternate with complete crop failures. Experts have proposed that each farmer turn over part of his surplus in good years to an insurance fund, from which he could draw in years of drought. The chief danger in such a plan is in encouraging wet-year production beyond profitable levels.

All such measures have helped in the past and will continue to help. But agricultural and weather experts alike say that the only safe way to escape the penalties of drought is for farmers not to cultivate lands subject to drought except by methods suited to the situation, and for nations, so far as possible, to see that individuals follow this policy, designed as it is to protect resources upon which all must rely.

DRUGS. Your corner drug-store is a museum of strange and wonderful things. The drugs assembled there, marshaled in orderly rows of shining glass bottles, have been brought from every corner of the world to help nature restore you to health when you fall sick. A single prescription may contain substances brought from five continents.

Side-wheeled steamers have chugged far into the upper reaches of the Amazon for cinchona bark, from which quinine is made, and coca leaves from which cocaine is extracted. Camel caravans have wound along snaky paths down through the hills of Persia and Arabia to the Aleppo market with their loads of gum tragacanth, which gives consistency to pills, reeking asafetida, used to stop hysteria, and colocynth, a powerful cathartic. Dog sledges have crossed the frozen plains of Siberia, swift dahabiyehs have taken advantage of the Nile flood, bullock carts have crawled creaking over the long roads of India, and down myriad Chinese riverways unwieldy junks have sailed, to bring to market such important drugs as opium, nux vomica, ajowan oil, and other healing substances on the way to the corner drug-store. The animal, vegetable, and mineral kingdoms alike have contributed to this purpose.

Today the discovery of valuable remedies is not left to chance. Great drug manufacturing establishments employ chemists who are constantly seeking new drugs and experimenting with their effects.

The 10,000 or more drugs that are used by modern physicians are generally divided into groups named according to the effect produced upon the human body. Thus we have anodynes or "pain soothers," which may be hypnotics such as chloral, anesthetics like chloroform, or narcotics like cocaine; and we have stimulants like strychnine, mustard, alcohol, spirits of ammonia, etc. Drugs which prevent or allay fever, such as salicylic acid, are called antipyretics; those which prevent infection are antiseptics; those like adrenalin, which draw together cut or torn tissue and check bleeding, are called astringents. This adrenalin is one of many drugs drawn from animals. It is made from a tiny gland of cattle, found near the kidney, and even one-millionth of a gram will affect a grown man. It also is a powerful heart stimulant—so much so that in many cases injecting it into the heart of a person apparently dead from drowning or shock will start the heart again.

Modern science has found in coal-tar a rich drug mine. The disinfectant carbolic acid, and such drugs as acetanilid, phenacetin, phenolphthalein, and a host of others are derived from this source.

The drugs of recognized value and known composition in America are listed in the 'United States Pharmacopeia', designated as the legal standard by the Pure Foods and Drugs Act of 1906. All drugs prepared according to the formulas of the 'Pharmacopeia' bear the stamp "U. S. P." upon box or label. Few drugs, however, should be employed except on a physician's advice. Only a small number are *specifics*—that is, adapted to cure or prevent some special disease as quinine cures malaria—and most of them are injurious if taken in large quantities or for long periods. (*See* Medicine and Surgery.)

DRUM. Some historians tell us that the drum was the first musical instrument made by primitive man, though others claim this place for the flute. Among savage tribes drums were used on every occasion. They called the tribe together for battle, they beat the time for the dancers and the singers, and they played an important part in religious ceremonies. Among the ancient civilized nations we find several kinds of drums. The Egyptians used a small hand drum; the Chinese used a large drum made like our bass drum; and the Hebrews' favorite drum seems to have been a sort of tambourine.

The many shapes and sizes of drums, no matter where found, all fall into three classes: first, those made of a single skin stretched over a frame which is open at the bottom, like the tambourine; second, a single skin on a closed vessel, like the kettledrum; third, two skins, one at each end of a cylinder, like the bass drum.

The kettledrums are the most important in the orchestra today. Vellum, or calf skin, is stretched over a hollow hemisphere of metal, quite the shape of the iron pot of our great-grandmothers. This skin is held in place by a ring which can be tightened or loosened by means of screws, thus making the pitch higher or lower. Kettledrums are usually played in pairs; one tuned to sound the "do" of the scale, and one to sound the "sol." Three kinds of drumsticks are used; one with sponge tips for soft strokes, one with leather tips for medium, one with wooden tips for loud sudden tones.

The bass drum and the snare drum do not produce sounds of any definite pitch. The booming thud of the big drum is chiefly employed to mark rhythm or emphasize climaxes. The snare drum, so called because catgut strings or snares are stretched across the head to make the sound more brilliant, finds its chief use in military bands. In the orchestra it serves to add brilliancy to crescendo passages.

DRUMMOND, WILLIAM HENRY (1854–1907). The wild rugged beauty of Canada, and the spirit of romance and adventure, now fast disappearing, will always remain fresh and living in the verses of the Canadian poet-doctor, William Henry Drummond. Above all he has caught the spirit of the *habitant*, as the French-Canadians of the farms, woods, and lumber camps are called. He has made these simple hardy people speak in their own French-English dialect, making them all the more real and lovable through their broken speech and revealing the true heart beneath the rough exterior.

Born in County Leitrim, Ireland, Drummond was taken to Canada by his parents when a boy. He worked for a time in the telegraph service at Bord-à-Plouffe (Quebec province) in the center of the lumber trade, and there for the first time came in contact

with the *voyageur* and the *habitant.* When, after his graduation from McGill University and Bishop's Medical College, he entered upon the practice of medicine, he chose a little community in which there were many of the French-Canadians, together with Indians and half-breeds. Robust and athletic, fond of sport and of outdoor life, he delighted in the companionship of the people who lived close to nature. He won their friendship by his sympathy and understanding, as well as by the multitude of good deeds for which he, as a country doctor, found opportunity. Afterwards Dr. Drummond became Professor of Medical Jurisprudence at Bishop's College in the same province, and won many honors; but his proudest title remained simply "*Habitant* Drummond."

Drummond's poetical works appeared in the following volumes: 'The Habitant and the French-Canadian Poems' (1897); 'Phil-o-rum's Canoe and Madeleine Vercheres' (1898); 'Johnnie Courteau and Other Poems' (1901); 'The Voyageur and other Poems' (1905); 'The Great Fight' (1908).

DRYDEN, JOHN (1631–1700). One day near the close of the 17th century a little lad was brought to Will's Coffee House in London, the great gathering place for literary men, to gaze upon the greatest writer of the time. That little lad was Alexander Pope, and that great man, whose ideas of poetic composition he was to follow and carry still further, was John Dryden,—poet, critic, and essayist.

Dryden taught that correctness, polish, and elegance, rather than originality, imagination, and feeling, were the essentials of good poetry. He chose the regular heroic couplet (two lines of iambic pentameter rhyming together) as "fittest for discourse, and nearest prose." His age was indeed an age of prose, and although he exerted a great influence on the poetry of his own period and the one which followed, his most permanent influence in English literature has been not in poetry, but in prose. Indeed modern English prose style may be said to begin with Dryden, and although we no longer place him with the first of the poets, he is still regarded as a great critic.

Many of his lines have passed into the currency of everyday speech, as for example:

> None but the brave deserves the fair.
> Men are but children of a larger growth.
> Few know the use of life before 'tis past.
> Great wits are sure to madness near allied.

Born in the little village of Aldwinkle in Northamptonshire, he came of Puritan stock, and his first important poem was an elegy on the death of the Puritan leader Cromwell, but he turned Royalist and welcomed King Charles II with another poem, 'Astraea Redux'. Later he also changed to the Roman Catholic faith, which he defended in an allegorical poem, 'The Hind and the Panther'.

For a long time Dryden wrote only plays—bombastic heroic tragedies, and comedies which reflected the low moral tone of the day. He also wrote several personal and political satires, of which 'Absalom and Achitophel' is the most powerful in English literature. He made translations from the Greek and Latin classics, and wrote a number of critical essays in the form of prefaces to other works. But of all his works, his beautiful odes, 'Alexander's Feast' and 'A Song for St. Cecilia's Day', are the favorites today.

DUBLIN, IRELAND. Pirate raids, battles and sieges, and riots and rebellions crowd the long story of Dublin, capital of Ireland, or Eire. The story is filled also with the names of great men—Wellington, Swift, Steele, Moore, Sheridan, Emmet, O'Connell, Parnell, and scores of others—for Dublin has been the metropolis of Ireland and the nursery of Irish genius from the early centuries of the Christian era.

It is a spacious and leisurely city, with stately old mansions, splendid public buildings, and wide green squares. But for a city of its size and importance, its industries are few. Politics, literature, and social activities have occupied the attention of its inhabitants, rather than commercial pursuits. Brewing, distilling, textile manufactures, ship-building, and the exporting of farm produce are the chief industries.

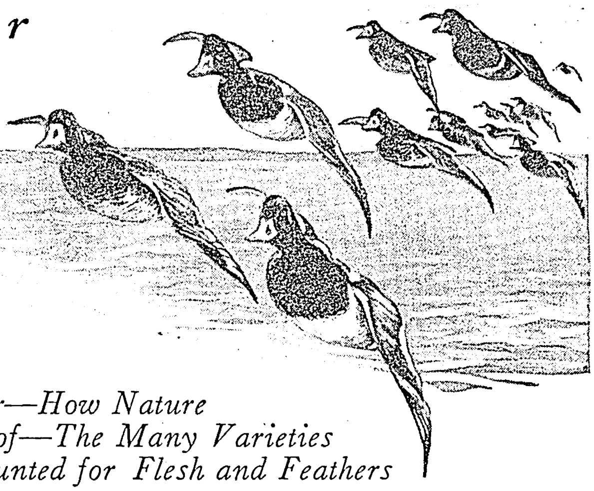
Dublin lies near the center of Ireland's east coast at the foot of the high rugged promontory of Howth. In the heart of the city is the 20-acre park called St. Stephen's Green. A short trip thence brings you to O'Connell Bridge, one of a dozen bridges over the Liffey River, which cuts Dublin from west to east. The river is lined on both sides by massive quays, nearly all built of granite.

O'Connell Bridge links the famous 120-foot wide Sackville (or O'Connell) Street on the north side of the Liffey with the district to the south, where lie many of the shops and public buildings. Here are the huge colonnaded semi-circular Bank of Ireland, formerly the Irish Parliament House, and the large group of buildings comprising the University of Dublin. The aristocratic section comprises much of the eastern half of the city, toward the bay. In dismal contrast to its mansions and splendid squares and terraces is the squalid slum district, with its crooked streets and wretched hovels, in the southwestern part of Dublin.

Among the historic buildings the chief is the Castle, originally built in the 13th century and formerly the seat of the Irish government. Notable also are the Protestant churches, St. Patrick's Cathedral and Christ Church. St. Patrick's, though in a poor section of the city, is a magnificent Gothic structure commenced between 1220 and 1260. Its most famous dean was Jonathan Swift. Christ Church, in the early English Gothic style, was founded in 1038 by a Danish king of Dublin. There are many beautiful Catholic churches and numerous monuments and statues.

Many of Dublin's finest buildings were wrecked in the revolt of 1916, when an Irish republic was proclaimed in expectation of German aid to be brought by Sir Roger Casement, and in the rebellion of 1922. Nearly the whole of Sackville Street was reduced to ruins. Phoenix Park, a magnificent wooded area of 2,000 acres, with great herds of deer, is just outside the city. It was the scene, in 1882, of the assassination of the chief secretary for Ireland and his undersecretary. Population (1936 census), about 468,000.

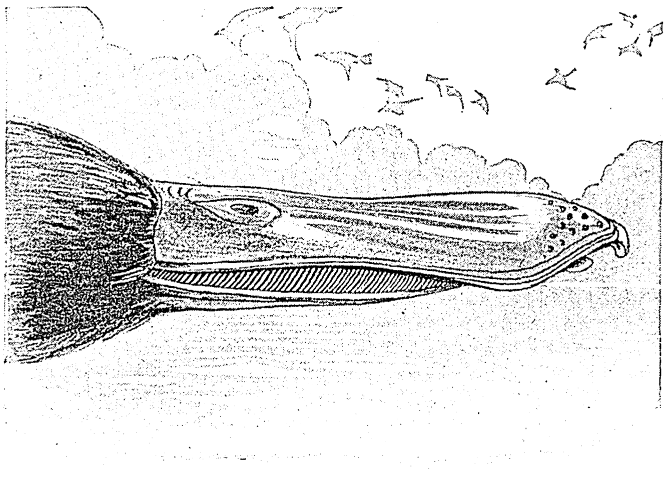
That Great Traveler THE DUCK



Expert Flyers, Swimmers, and Divers, Whose "Quack" Language is Known the World Over—How Nature has Made Them Waterproof—The Many Varieties and How They are Hunted for Flesh and Feathers

DUCK. Over a mile a minute is the wild duck's speed record for short flights, and he is also an expert swimmer and diver. Nature has been very good in clothing these birds, for in addition to a coat of closely packed feathers, she has provided them with an inner dress of thick down that protects them from both wet and cold. The molting, too, she has arranged so that at no time is the power of flight lost, for the quills of their tail and strong wings are molted in pairs, leaving always a perfect balance. A special spring shedding of the feathers provides a soft lining for the nest-home. The web feet are set in the best position for swimming; this, however, has the disadvantage of bringing the legs so far back on the long body that the bird walks with an awkward waddle. The male bird, called the "drake," has showy plumage, but the female generally wears feathers of dull brown and buff. Wild ducks feed on insects, small water-creatures, grass, roots, and seeds. They nest in trees or in marshy ground.

A DUCK'S DISH AND SPOON



Eating has become a very simple process for certain varieties of ducks. They simply open their bills and take in a mouthful of water or soft mud. When they close their bills, the sieve-like fringes you see here let out the liquid and hold the solid particles of food.

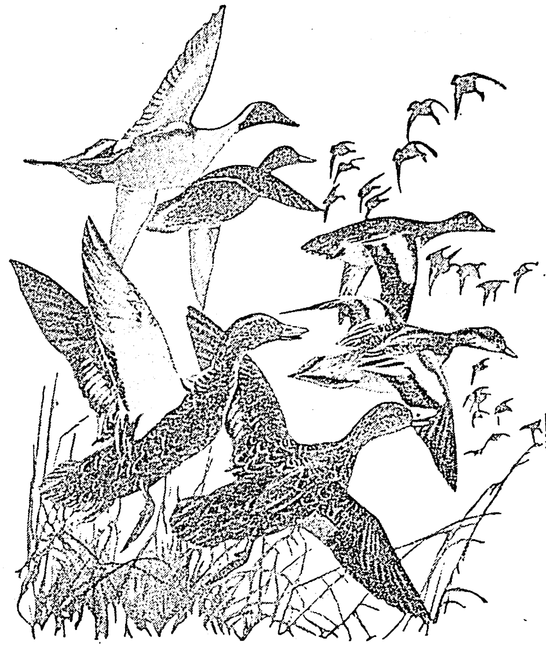
The 125 wild species are found in all parts of the world, except the Antarctic continent. They are of two classes—the sea-ducks and the pond ducks. The distinction is mainly one of habit and food, though there is also this difference in structure—in the pond and river species no webbing connects the hind toe with the foot, while in sea-ducks the hind toe also has a lobe or web.

Of the river ducks, the mallard is the most important. This species is abundant over most of the Northern Hemisphere, and from time immemorial has furnished mankind with appetizing food. It is the chief water-fowl of most game preserves, in some of which 10,000 birds are reared annually. During the winter and spring the drake wears a head-dress of glossy green with purple lights; his back is grayish-brown, while his wings, of the same color, are banded with greenish-purple and white. The under-feathers are a lighter brown-gray. During the summer his dress is dusky-brown, much the same as that of his mate (for illustration in colors *see* Birds).

The teal is the bantam of the family, but it holds the flying record. Shoveler or spoonbill is the name given to a species whose great clumsy bill gives the bird a topheavy appearance. Around the edge the bill is furnished with a set of fringed bristles, which act as a sieve through which mud and water run out, leaving the food within.

The wood-duck is one of the most richly dressed birds of the United States. The drakes are green, blue, and purple, with white streaks above and red, yellow, and white below. The females are brown above and yellowish brown beneath. Both duck and drake have long full crests, narrow bills, and long soft broad tail feathers. These birds build in hollow trees, sometimes 40 feet from the ground and a mile

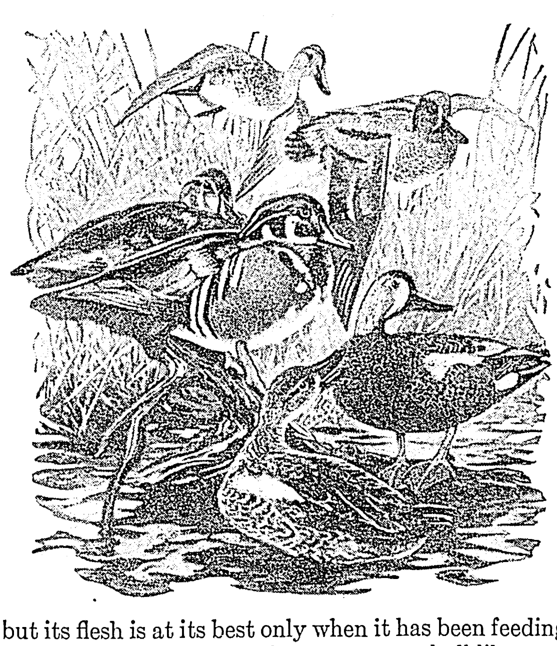
SOME PROMINENT FAMILIES OF "QUACK LAND"



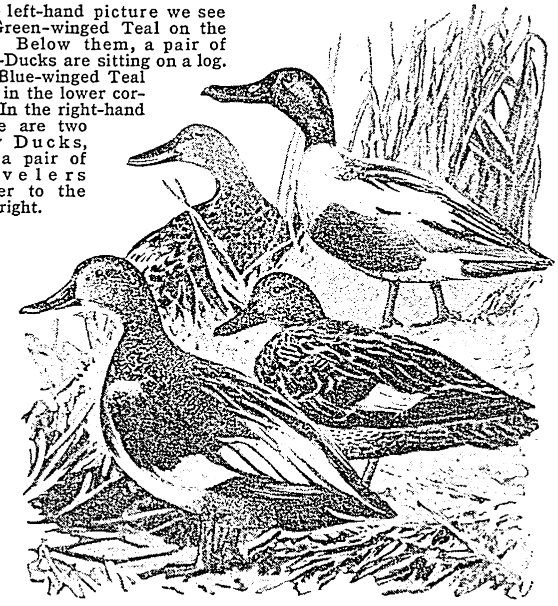
On the left are three kinds of Ducks, just taking flight from a marshy spot. The upper one is a Pin-Tail, the two below are Black Ducks, and the rest are Baldpates. On the right Mr. and Mrs. Mallard are just starting out from home.

from the water. When ready to leave the nest, the babies are encouraged to parachute to the ground and then in a family party are led to the water.

Of the sea-ducks the most important is the canvasback, the bird that made Chesapeake Bay famous. It is considered a greater luxury than "quail on toast," but its flesh is at its best only when it has been feeding on wild celery or upon the *wappato*, a bulblike root which it finds in the Far West. The name canvasback was given because the grayish feathers of its back and sides are so compact as to resemble coarse canvas. It is a hardy bird and on its autumn migration reaches the United States late in October. It may remain in the Great Lakes region until driven out by ice. A few are found on or near the New England coast, but the great majority move to the south. Chesapeake Bay was formerly the great feeding ground of the canvasback, but now they are found in greater numbers about Pamlico and Albemarle Sounds. They dive in reedy waters for the roots on which they feed.

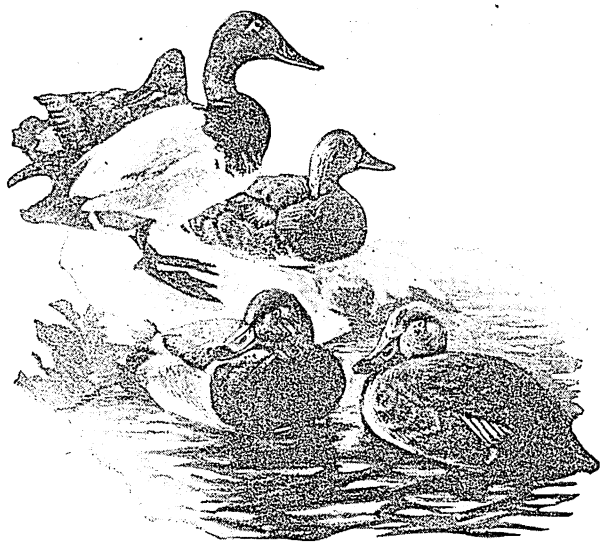


In the left-hand picture we see two Green-winged Teal on the wing. Below them, a pair of Wood-Ducks are sitting on a log. Two Blue-winged Teal stand in the lower corner. In the right-hand picture are two Gray Ducks, with a pair of Shovelers further to the right.



Very closely related and equally good as food, when equally fed, is the redhead. It is smaller than the canvasback and has more black in its plumage. The redhead is found on the Atlantic and Pacific coasts.

BILL OF FARE RIVALS



The Canvasback Ducks at the top and the Redhead Ducks below look very much alike, except that the Redheads are somewhat smaller and darker. Both kinds are highly prized as food.

The mergansers (sometimes called sheldrakes) are a small group of fish-eating ducks. They have striking and beautiful plumage—both sexes being usually crested. The flesh is of a strong fishy flavor.

The Duck that Gives the Eiderdown

The eider ducks are native to both northern Europe and America. Their value lies entirely in the down and the eggs they furnish. The duck pulls down from her breast and makes a padded blanket that completely covers the nest. Upon the removal of the down and eggs she repeats the process, including the laying of more eggs. If the down-gatherers again empty the nest, it is said that the drake denudes his breast so that the nest refilled by the duck may still be properly fitted out with its blanket. The down has such commercial value that in some parts of Europe the birds are conserved and protected.

The domestic ducks of North America and Europe are from the mallard stock, but in the East and Africa other species have contributed. The White Aylesbury and White Pekin came from China; they were first introduced into the United States in 1870.

Ducks belong to the order *Anseriformes*, which also includes the geese and swans. Scientific name of mallard, *Anas platyrhynchos;* of green-winged teal, *Nettion carolinense;* of shoveller, *Spatula clypeata;* of wood-duck, *Aix sponsa;* of canvasback, *Nyroca valisineria;* of redhead, *Nyroca americana;* of American merganser, *Mergus merganser americanus;* of northern eider, *Somateria mollissima borealis.*

DUCKBILL. Here is a riddle of the old-fashioned kind that might have puzzled even Oedipus, the old Greek who made such short work of the Sphinx. See if you can guess it:

"It has a beak like a duck, hair like a cat, and a tail like a beaver. It has four legs and web-feet. It lives both on land and in the water, lays eggs and hatches them like a bird, but feeds its young with milk from the breast. What is it?"

Perhaps you give up at once; or perhaps you will exclaim: "There is no such animal!" This was the attitude of the British scientists who saw a stuffed specimen for the first time, and declared it was a "clever fabrication."

But it was not long before a living example of this freak of nature was brought from Australia, and the scientists promptly called it *Ornithorhyncus paradoxus,* which in Greek means "bird-billed contradiction." It was a good name, for this creature not only contradicted the doubters, but contradicted also the former laws governing the shapes and habits of animals. For ordinary purposes, however, it is known as the "duckbill platypus" (*platypus* meaning "flat-footed").

This creature, perhaps the strangest of all living things, is only found along the streams of south-eastern Australia and of the island of Tasmania. It is a good swimmer, diving to the muddy bottoms in search of water insects and worms which it roots out with its broad flat beak.

Its den, built far back in the bank of the stream, usually has two openings, one under water, the other concealed by weeds above the surface. There the female builds her nest and hatches her eggs, usually two in number, and there she suckles her young. The young first develop teeth, but these soon fall out to make way for the tough horny plates with which the adult chews its food.

AN "IMPOSSIBLE" CREATURE

The Duckbill is the queerest of all animals. It breaks all the rules. It has a beak and web-feet like a duck and it lays eggs. But it has hair and feeds its young on milk from the breast. That seems to make it a cross between bird and mammal. Then, as if this were not enough, it has poison glands like a snake, which are connected with spurs on the heels.

The male duckbill is the only poisonous mammal in the world. It has on its hind legs grooved spurs con-

nected by long tubes with poison glands situated near the thighs. The poison closely resembles snake venom, but appears to be seldom used.

The voice of these curious animals is like the growl of an angry puppy, but they are exceptionally timid, rarely showing more than their nostrils above the water. Once captured, however, they are gentle and easily tamed, recognizing their friends, answering to their names, and eating from their keeper's hand.

A land-dwelling relative of the duckbill is the Echidna or "spiny ant-eater," also a native of Australia. It has quills like a porcupine and a long slim beak. It also lays eggs and suckles its young, but the eggs are hatched in a pouch on the mother's stomach, like the pouch of a kangaroo.

The duckbill and the spiny ant-eater are looked upon by scientists as modern illustrations of those ancient "transitional" forms of life, produced while nature, according to biological theory, was developing mammals, birds, and reptiles from the primitive types which existed many thousands of years in the past. The structure of the duckbill, particularly, shows close resemblances to certain ancient fossils, and the shape of its bones is part bird, part reptile, and part mammal in character.

That these creatures should be found only in the Australasian region is explained by the theory that these lands became separated from their neighbors long ages ago.

DULUTH', MINN. Snorting tugs and giant freighters, belching forth clouds of black smoke, plow their way to and fro in that natural harbor—one of the finest in the world—where Duluth, at the head of Lake Superior, proves itself truly the "metropolis of the unsalted seas" and gateway to the great Northwest. Some of these long low freighters are taking on cargoes of red hematite iron ores from the rich Vermilion and Mesabi ranges for the iron and steel plants of Pittsburgh and Chicago. Others are loading with magic speed millions of bushels of wheat from Manitoba, the Dakotas, and the Red River valley for the mills of Buffalo and other lake ports. Still others are taking on huge cargoes of lumber and flour; while at some of the world's largest coal docks, vessels now on their return trips are discharging millions of tons of coal to be sent by rail far and wide through the Northwest.

Because Duluth is the nearest shipping point on the lakes for this region of vast agricultural and mineral wealth, it is one of the world's great ports. The Duluth-Superior Harbor, which it shares with its neighbor, Superior, Wis., is normally second only to the Port of New York in the amount of tonnage handled. These shipping facilities and the raw materials of the region make Duluth a flourishing center for trade and manufacturing. Among its products are iron and steel and allied products, leather, flour, cement, meat, lumber, refrigerators, clothing, and various kinds of machinery.

Situated on terraced bluffs 600 to 800 feet high, Duluth is also a most attractive residential city, with fine parks and boulevards. The most beautiful drive is the 30-mile Skyline Parkway above the city. An interesting sight is the Aerial Lift Bridge over the ship canal. The central span lifts 138 feet to permit the passage of large vessels.

Cultural institutions include the Civic Symphony Orchestra, the Little Theater, the Children's Theater, the Children's Museum, the St. Louis Historical Society Museum and Library, the State Teachers College, the Darling Observatory, and the Duluth Zoo.

Duluth was named for Daniel Greysolon, Sieur du Lhut, a French explorer who came to the head of Lake Superior in 1679. A fur-trading post was established in 1817, and the first permanent settlement was made in 1853. The city grew rapidly after 1880 with development of the iron deposits and the extension of railroads into the wheat regions of the Northwest. The commission form of government was adopted in 1912. Population (1940 census), 101,065.

DUMAS (*dü-mä'*), ALEXANDRE (1803–1870). Nearly every critic who has written of this clever French novelist has qualified his praise. One says that Dumas' novels are "outside literature"; another that his writings are careless; and yet they all agree that for charm, movement, clever talk, and brilliance he is unsurpassed. Robert Louis Stevenson tells of sitting down with one of Dumas' novels, 'The Vicomte de Bragelonne', "for a long, silent, solitary lamplight evening by the fire." And still he does not know why he should call it silent "when it was enlivened with such a clatter of horse-shoes, and such a rattle of musketry and such a stir of talk," or why he should call those evenings solitary in which he "gained so many friends."

Alexandre Dumas was born in 1803 in Villers-Caterets, a little town near Paris. His pictures show a smiling face surrounded by a mop of black hair. His lips are thick, showing plainly the Negro blood that he got from his Haitian grandmother. His widowed mother was unable to give him much of an education and he began at an early age to earn his living as a lawyer's clerk. But he read widely and soon won recognition as a writer. His first successes were as a playwright, and it was not until 1844 that he published the first of the brilliant historical novels on which his fame chiefly rests.

The astonishing thing about Dumas' work is its volume. He published 60 plays and 200 novels and books of travel. Of course no single writer could produce that amount of manuscript. Dumas hired various young apprentices at fiction to look up the historical material, to write the skeletons of his stories, which he then proceeded to fill in with incident and dialogue. Nor was Dumas satisfied to hunt fresh material; he often borrowed from Shakespeare or anyone else he fancied. He defended his method by saying that "the man of genius takes his material where he finds it, and he doesn't steal but conquers."

Naturally, the mass of fiction which he put out was uneven. The best is thought by many to be 'The Three Musketeers', and the two sequels, 'Twenty Years After' and 'The Vicomte de Bragelonne'. In

this series he follows the fortunes of D'Artagnan, a Gascon soldier, and those of Aramis, Porthos, and Athos, his three faithful friends. The narrative clings closely to French history between the years 1626 and 1671. Louis XIII, Louis XIV, Richelieu, Anne of Austria, Buckingham, Mazarin are made alive and vigorous. When Dumas doesn't find enough intrigue, mystery, love affairs, and duels to satisfy him, he adds as his imagination prompts him. He expands unimportant characters until they fill the canvas of his scenes.

But more interesting even than the merely historical background is the spirit of rollicking good-humor, self-sacrificing friendship, and daredevil adventure that animates the books. Dumas' heroes come out of their worst scrapes with wounds that heal quickly, with spirits that are undaunted. For pure romance their equals are hard to find.

Dumas' personal history was a stormy one. Feminine intrigues, politics, debts, great wealth, exile, and honors followed in rapid succession. He acknowledged as his son and gave his name to Alexandre Dumas, the Younger (1824–95). The son achieved a place in literature chiefly as a dramatist. 'Camille', his best known play, was long the favorite rôle of the great French actress Sarah Bernhardt.

Dumas' chief works are: 'Les Trois mousquetaires' (The Three Musketeers), 1844; 'Vingt ans après' (Twenty Years After), 1845; 'Count of Monte Cristo' (1848); 'Le Vicomte de Bragelonne' (1848).

DUN'KIRK, FRANCE. An important commercial seaport, Dunkirk lies in the extreme north of France on the Strait of Dover. The largest ocean-going vessels dock at its five miles of quays, connecting the city with the principal ports of the world. A system of canals facilitates its commerce with Belgium and the rich agricultural regions, coal mines, and industrial towns of northern France. Railroads bring it into communication with large French manufacturing centers.

In the World War of 1914–1918 Dunkirk escaped serious damage, only to be utterly demolished by war 22 years later. The bombs of the fleeing French and British troops, as well as those of the conquering Germans, helped to raze the city. Before the port fell, more than 300,000 troops were evacuated to England in one of the most remarkable military feats in history. An improvised armada of almost 900 ships, most of them small craft manned by volunteers, performed the rescue in the face of frightful aerial and artillery bombardment.

The name Dunkirk (French *Dunkerque*) means "dune-church." It is said that St. Eloi founded a small church, or "kirk," here on the sand dunes in the 7th century, and that around this the city grew. In the 10th century it was fortified by Baldwin III, count of Flanders. With Flanders it passed successively under the rule of Burgundy, Austria, and Spain. England held it for four years following 1658, but Charles II, needing money, then sold it to Louis XIV. It has since been a part of France.

The chief industries are shipbuilding and trading by sea, iron founding, and the manufacture of machinery. There are also petroleum refineries, and linen, cotton, sailcloth, fishing nets, and soap are manufactured. Every year Dunkirk sends a fleet to the cod fisheries of Iceland. The preparation of cod-liver oil is important. Population, about 31,000.

DÜRER (*dü'rĕr*), **ALBRECHT** (1471–1528). The story of Albrecht Dürer, "prince of German artists," is the story of a poor boy whose genius and industry made him one of the greatest figures in the stirring times of Luther and Charles V. At the height of his fame, emperors, kings, statesmen, and the master artists of the day were proud to call him their friend. And when he traveled, he naively tells us, "the people did obeisance unto me as if they were leading some great lord."

Dürer was one of 18 children of a humble goldsmith in Nuremberg, Germany. Think how hard the father must have worked to fill so many hungry mouths! "My father," writes his son Albrecht, "took special delight in me. Seeing that I was industrious in working and learning, he put me to school; and when I had learned to read and write, he took me home from school and taught me the goldsmith's trade."

But Albrecht was more interested in drawing and painting than in the practical side of this art. Even as a child he had astonished everyone with his lifelike sketches and his skill in drawing perfect lines and circles without ruler or compasses. So at 15 he entered the shop of the best painter of the town, where his rude and mischievous companions played many a trick on him. But heedless of all obstacles, the lad pursued his chosen course, became skilled in the use not only of the painter's brush, but also of the engraver's tools.

His apprentice days over, Dürer traveled in Germany and Italy, and speedily became famous for the liveliness of his portraits and other paintings and for the richness of their coloring. What is even more important, he was turning out an enormous number of examples of the new art of engraving on wood and copper.

This art was still in its infancy. Men had only just begun to realize its infinite possibilities. Paintings were expensive and only the wealthy could possess them. But here was an art which made it easy to multiply and spread among the people pictures telling the stories of sacred and classical history, and to drive home for the multitudes who could not read the points in religious and social controversies.

The engraver's art was especially congenial to Dürer, and he carried it to its highest point of both craftsmanship and imaginative expression. Before Dürer, engravings were crude in design and execution. He filled in the bare outlines with light and shade, and helped to set the pattern of engraving for all time.

But the man Dürer was greater than his art. His interests ranged over all of the many-sided life of that wonderful Renaissance period. He was a zealous

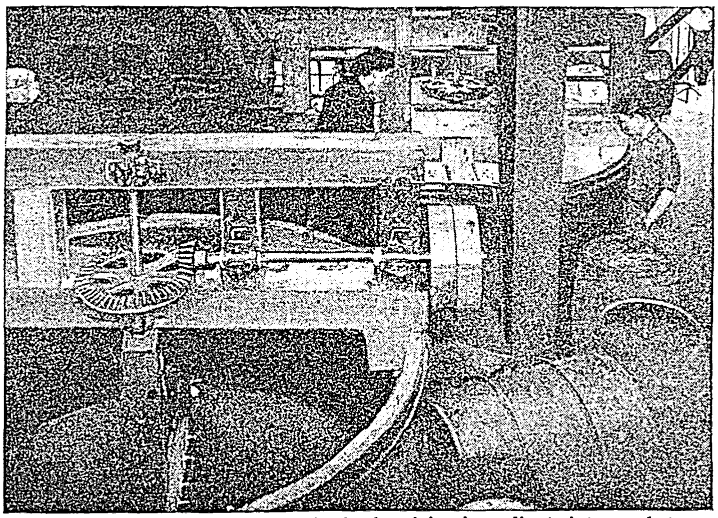
patriot, preferring to spend his life in his home town of Nuremberg rather than to be feted in the courts of princes and emperors. His scientific, literary, and religious enthusiasms were so ardent that in the later years of his life he devoted far more time to them than to his art; and some of his closest friendships were with such men as the scholar Erasmus and the religious reformer Luther.

The character of the man is well brought out in his own words: "Attentively regard Nature and take her for your guide, and do not depart from her, imagining that you will fare better by yourself. Truly, Art is hidden in Nature. Never think to do anything better than God has done it, for your power is pure nothingness compared with the creative activity of God."

Dürer was incredibly industrious. His own list of his works enumerates 1,254 pieces. Of his paintings, 'The Adoration of the Magi' (Uffizi Gallery, Florence) and 'Christ on the Cross' (Royal Gallery, Dresden) are among the best known. 'The Life of the Virgin', a series of 21 cuts, and 'The Apocalypse', a series of 15, rank among his best woodcuts. 'The Knight and Death', 'Melancolia', and 'St. Jerome in his Study' are considered the greatest of all engravings on copper.

DYES. Almost as old and as much desired as food and clothing are the colorings to make clothes beautiful. Since early times people have used dyes and stains, and have gone to infinite trouble and expense to get them. Some of the natural dyes, from plants and animals, were in use probably 4,000 years ago. Natural dyestuffs abound everywhere, yet those which give vivid, beautiful, and lasting colors are not numerous, and early became prized articles of commerce. Such was the precious tyrian purple (really a crimson), which yielded immense wealth to the ancient city of Tyre. This was made from a Mediterranean shell-fish a thousand years before Christ, and later dyed the robes of Roman emperors and chief magistrates. Such, though less costly, were indigo (*see* Indigo), madder, turmeric, and later, cochineal (*see* Cochineal), and fustic, a yellow dye from the wood of a tree grown in South America and the West Indies.

WHERE COLORS FOR CLOTHES ARE MADE



In these big vats heavy machinery is slowly mixing ingredients into a substance which will turn out to be a dye for coloring cloth. It is a simple process, once the exact chemical reactions are known. But the difficulty lies in finding the substances which will produce the desired color.

Today man's instinctive love of color has built up great industries, for colors of infinite variety are now made cheaply and plentifully in factories. Indigo, once obtained only from plants, is now made from coal tar; it is chemically identical with the plant product, since coal itself is made from plants (*see* Coal-tar Products). The chemical structure of dyes is so well known that almost any color can be secured by retaining certain parts of the structure of the coloring molecule.

For ages practically all dyes were made from natural organic substances. No one dreamed that they could be made from inorganic substances. But in 1828 Friedrich Wöhler showed that organic compounds could be synthesized in the laboratory. And in 1856 an Englishman, Perkin, attempting to make artificial quinine from coal tar, derived a mauve substance from aniline, a coal-tar derivative. Aniline had first been isolated from indigo, and was so called from "anil," an ancient word which in many languages means "indigo." Perkin's mauve coloring was the first aniline dye. From this beginning the making of synthetic dyes grew rapidly. Germany was the first to see its possibilities, and before the World War of 1914–1918 German chemists held the secrets of hundreds of processes for making dyes, as well as much of the chemistry of the whole coal-tar industry. Hence they had practically a monopoly of such manufacture.

War Cost Germany Its Monopoly

The blockade of Germany during the war crippled the textile industries of America, Great Britain, and other countries. Before the war the United States imported 80 per cent of its dyes, and the materials for most of the remaining 20 per cent. American manufacturers met the emergency, and soon made dyes equal to those of German origin. Now America produces over 90 per cent of its dyes.

The first dyers were no doubt housewives like our own great-grandmothers, who dyed with the butternut, hickory, oak-galls, and other native vegetable substances the stuffs that they had spun and woven. Egypt, Persia, and India early perfected the art. India especially was the source of many of the best dyes until modern times. Indigo was the "Indian dye" to the Greeks and Romans. The dyers' art, at least commercially, was largely lost in Europe from about the fall of the Roman Empire until the Moors planted madder in Spain, and returned Crusaders revived dyeing in northern Italy. Thence

the art spread to France, Flanders, Germany, and England. The discovery of America gave the world many new dyes, particularly cochineal, logwood, and fustic. When the route around the Cape of Good Hope was opened up, larger quantities of dyestuffs were imported into Europe from India. Desperately but vainly did the European woad-growers fight the importation of the "devilish drug" indigo; but the whirligig of time had in store its revenges on the lordly indigo planters.

Chemical Behavior of Dyes

Not every coloring substance is a dye, for a dye, unlike a paint or a stain, becomes physically or chemically incorporated in the fibers of the dyed material. One theory, provisionally accepted by many for cotton dyes, at least, is that the dye on the fabric is held in "solid solution," as it were. Another theory, generally regarded as probable for silk and wool dyes, holds that there is a real chemical union between an acid dye and a basic fiber (*see* Acids and Alkalies), or between a basic dye and an acid fiber. It is believed the color in a chemical compound is due to the presence of certain oxygen atoms which are attached to only one other atom instead of to two, as they are in colorless compounds. This insecure arrangement has been likened to a loose bolt which rattles in a piece of moving machinery; the oxygen atom rattles, or vibrates, producing light waves which give the sense of color. It is believed all colored compounds contain such atoms.

Dyes are applied to raw stock, to the spun yarn, or to the woven fabric. "Discharge" processes treat the fabric so that it will discharge a portion of the dye to produce a white polka dot or other figure. Block dyeing, an ancient color art still in use, gives beautiful results by stamping the dye on the paper or fabric from a hand-carved wood block. "Resist" processes, by which a portion of the fabric is protected from the action of the dye, are exemplified in the batiks in which artists take so much interest. Batik printing has been skilfully practised in Java for perhaps 2,000 years. A coating of wax is put on the parts of a pattern that are to be protected from the dye before immersing the cloth in the color. Repetition of the process makes several colors possible. Sometimes screens of bolting cloth, on which the design is marked with a special dye-resisting paint, are placed above the material to be dyed.

Many Varieties of Synthetic Dyes

Dyes are closely related chemically to many other coal-tar products; they are a by-product in the making of explosives, and are derived from such similar sources as perfumes, extracts, and medicines. Synthetic dyes are of many kinds—acid, basic, phenolic, aniline, and others—and in each class there are many colors. Silk, wool, and cotton must have their special dyes, each with a wide range of color. Many materials, such as leather and fur, present special problems of dyeing. In some dyes, as in indigo, the peculiar structure giving the color is so modified in the process of preparation that when the cloth is taken from the dye bath it is white, and becomes colored only when exposure to air oxidizes the dye.

Many complex dyes require chemical processes for their formation; indigo, the most used of all dyes, was the subject of chemical research for years before it was put on the market in 1897.

Dyes are often fixed in the fibers by a "mordant," usually salts of aluminum, iron, or some other metal, by which the color is also sometimes modified; iron, for instance, produces darker shades than aluminum.

DYNAMITE AND NITROGLYCERIN. Nitroglycerin, the most powerful explosive in common use, was discovered in 1846 by the Italian scientist Ascanio Sobrero. It is made by treating glycerin with a mixture of concentrated nitric and sulphuric acids. Although used as a headache remedy, under the name "glonoin," it proved too difficult and dangerous for practical blasting purposes until Alfred Nobel of Sweden began his experiments in 1862. Nobel's brother was blown to pieces during the tests, and Nobel was forced to move his laboratory to a barge anchored out in the middle of a lake. Then a ship loaded with nitroglycerin blew up off Colon, Panama, and most of the nations of the world forbade their vessels to carry it. But the Swedish chemist refused to abandon his labors, and in 1866 he was rewarded by the invention of dynamite. This is today the commonest and safest of the high explosives, for the first time enabling man to blast away great masses of rock and other obstacles with comparative safety.

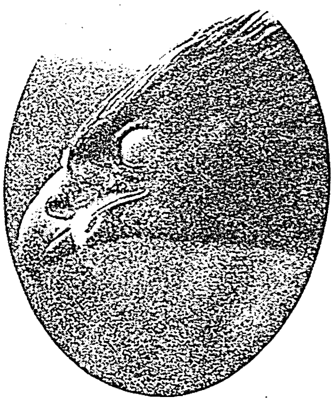
Dynamite consists of a mixture of the liquid nitroglycerin with some absorbent substance or "dope" giving it a solid form. The absorbent used by Nobel was kieselguhr or diatomite, a kind of earth formed by countless millions of tiny fossil plants known as "diatoms." Later wood pulp, sawdust, charcoal, plaster of paris, and many other substances came to be used. Perhaps the most powerful form of dynamite is the "blasting gelatin" devised by Nobel in 1875. This contains nitrocotton colloidally dissolved in nitroglycerin, and is waterproof. Many dynamites use ammonium nitrate mixed with nitroglycerin.

Ordinary dynamite is usually made in the form of "sticks" from one to two inches in diameter and about eight inches long. These consist of brown paper wrappers coated with paraffin to keep out moisture. If a small quantity of dynamite is set on fire, free from pressure, jar, or vibration of any kind, it will burn; but if the least blow strikes it while burning, such as the fall of a tiny pebble, it will explode with great violence. Dynamite is usually set off with a detonator or blasting cap. (*See also* Explosives; Glycerin.)

DYNAMO. A machine for transforming mechanical to electrical power is called a dynamo, from the Greek word *dynamis*, meaning power. In its most simple form a dynamo is merely a loop of wire rotating between the poles of a magnet and cutting the magnetic lines of force. The modern name for dynamo is electric generator. (*See* Electric Generator and Motor.)

E

EAGLE. Soaring high in the sky, or swooping like a thunderbolt on the hapless prey it has descried from afar, the eagle well deserves its reputation as "the king of birds." Its extraordinary power of sight, the terrifying majesty of its appearance, and the wild grandeur of the scenery in which it loves to build its aerie, have made it the universal emblem of might and courage from the most ancient times. Five thousand years ago the Sumerians of the city-kingdom of Lagash in the Euphrates valley used the "spread eagle" as the symbol of their power, as did imperial Rome, and as the United States does today. The coats-of-arms of the former Russian and Austrian empires bore double-headed eagles.



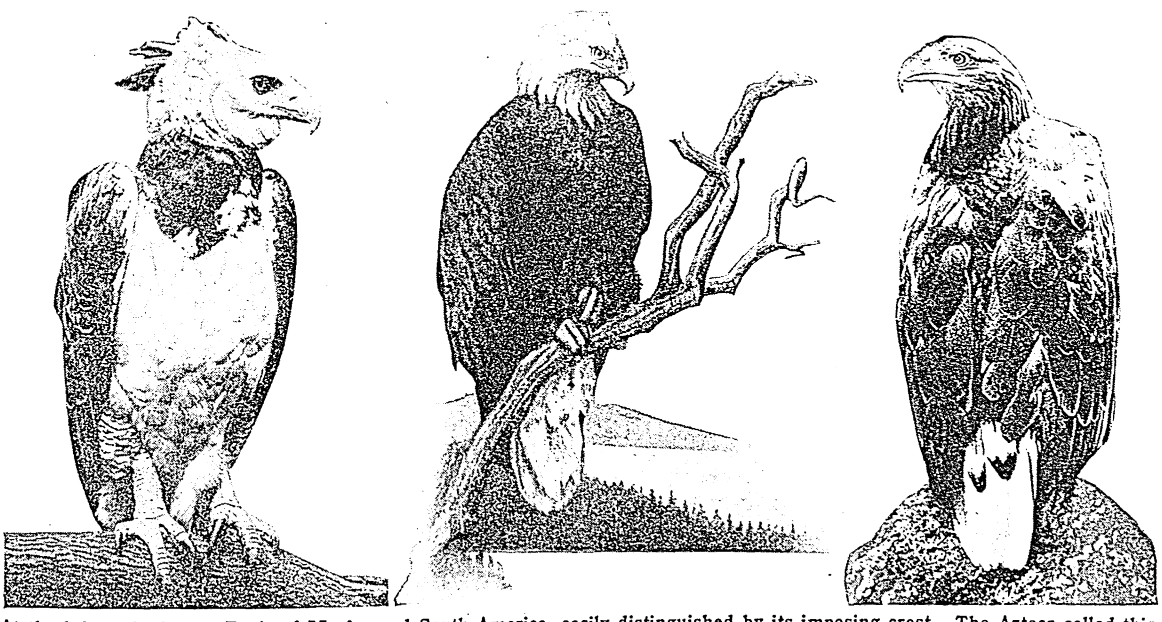
Here is a young Golden Eagle with his curious "third eyelid" drawn over his eye. It is a semi-transparent membrane, which probably protects the eye against the sun's glare.

In the words of John Burroughs, the American naturalist, the eagle "draws great lines across the sky; he sees the forests like a carpet beneath him; he sees the hills and valleys as folds and wrinkles in a many colored tapestry; he sees the river as a silver belt connecting remote horizons. We climb mountain peaks to get a glimpse of the spectacle that is hourly spread out beneath him. Dignity, elevation, repose, are his."

There are 40 or 50 species of eagles in all countries of the world, but only two species occur north of Mexico. These are the golden eagle common to Europe, Asia, and America, and the bald eagle which is peculiar to North America, and is taken as the national emblem of the United States. All eagles are birds of prey, and are related to the vultures, hawks, and falcons. They are supposed to attain great age. Their nests are structures of sticks, sometimes six feet across and six feet high, containing a cart-load or two of material.

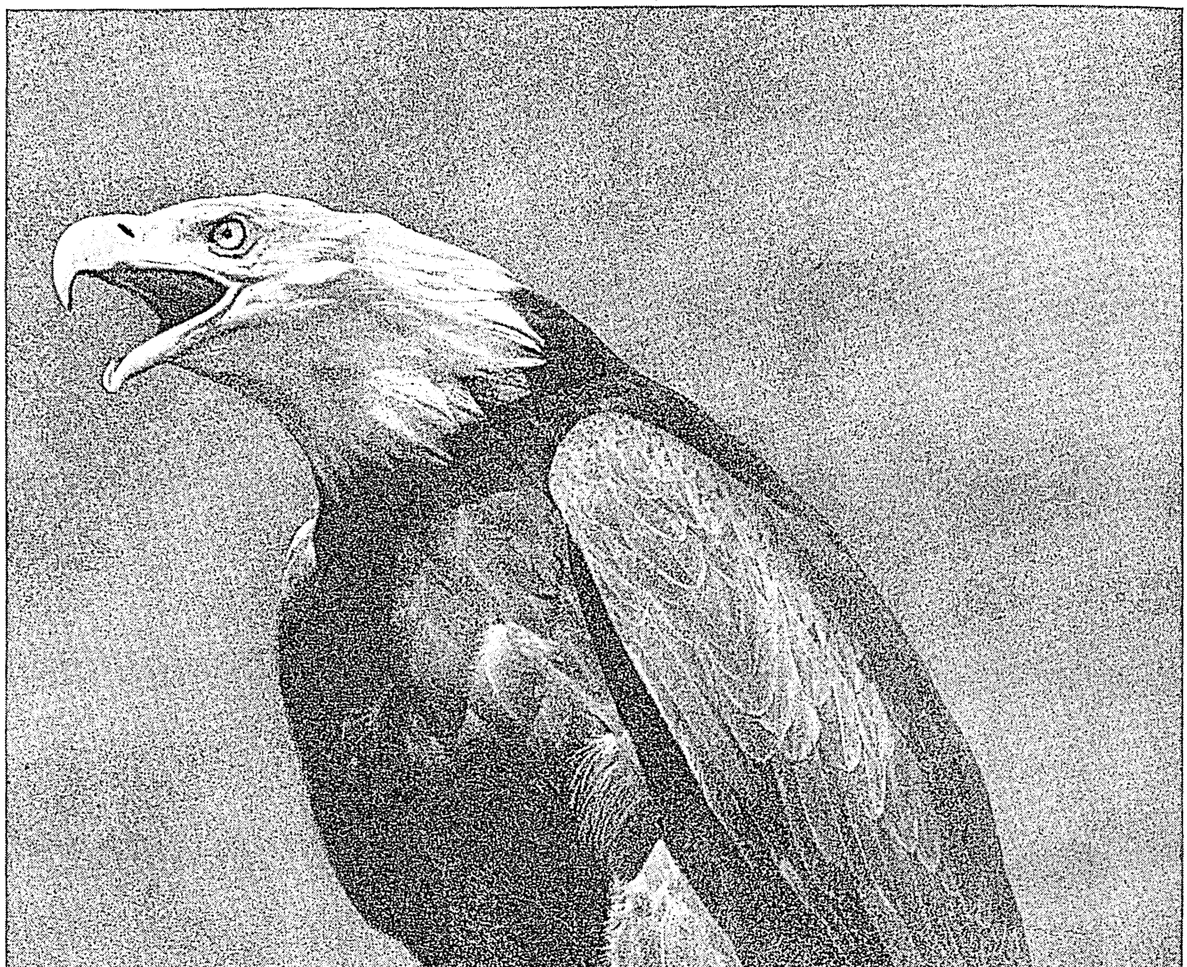
The golden eagle is a magnificent, mountain-loving bird. It is found in the United States from Mexico northward, but is far from common. It is more abundant in the Old World, but even there the sea-eagle is more common. The golden eagle is a large bird of

THREE FIERCE MONARCHS OF THE AIR



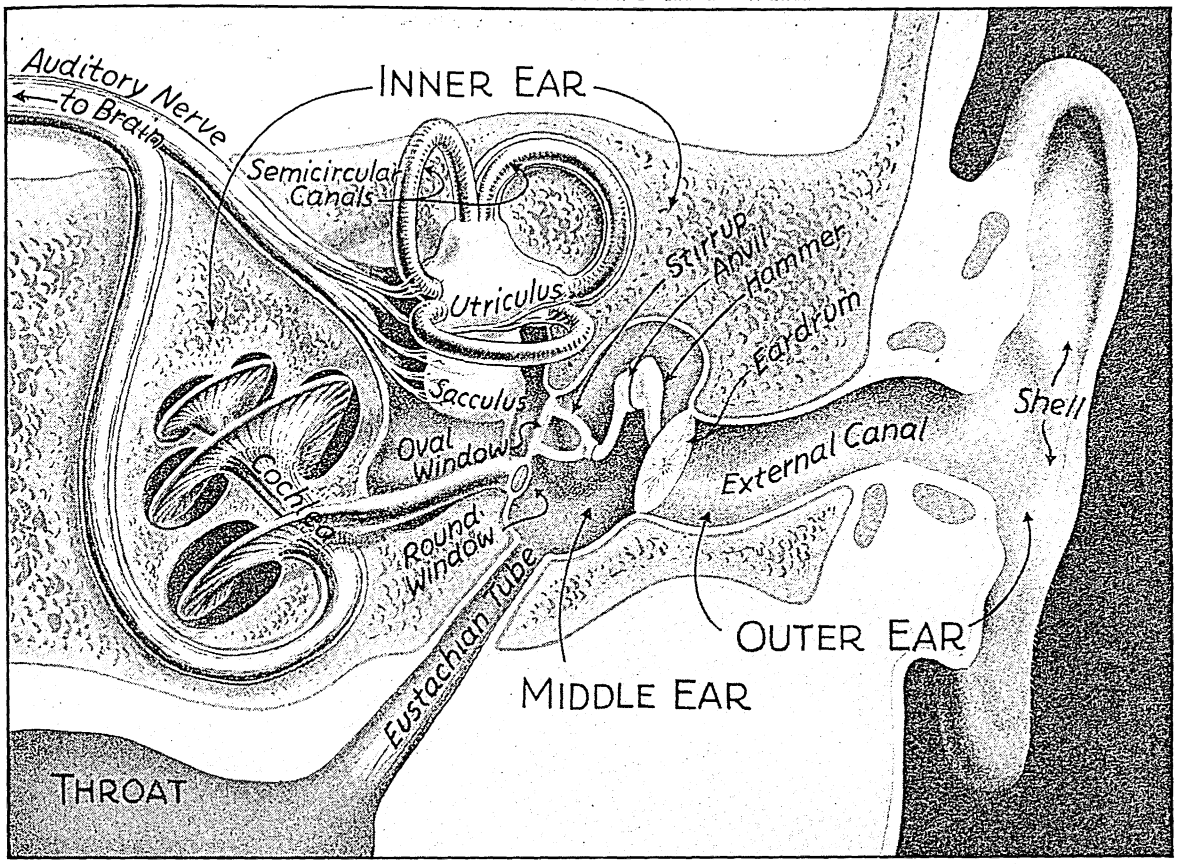
At the left is the Harpy Eagle of Mexico and South America, easily distinguished by its imposing crest. The Aztecs called this bird the "Flying Wolf," because of its ferocious disposition. In the middle is the Bald Eagle, or American Eagle, one of the noblest of all birds. It belongs to the Sea-Eagle group. At the right we see the Golden Eagle, famous for its graceful beauty and exquisite coloring.

THE AMERICAN BALD EAGLE, SYMBOL OF FREEDOM



The only one of the eagles distinctly American is the bald eagle, distinguished by its gleaming white head and white tail. The bird above is Jerry, inmate of the National Zoölogical Garden in Washington, D.C. Since 1940, the national bird has been protected against killing or capture by an Act of Congress. But this protection does not extend to Alaska, where the bald eagle is considered injurious to the fishing industry. Eagles mate for life and return year after year to the same nest. The female incubates the eggs for about 35 days, while the male feeds and guards her. The two or three eaglets remain in the nest for nine or ten weeks.

THE HUMAN EAR—ITS PARTS AND WHAT THEY DO



This diagram shows how the intricate machinery of the ear is divided into three sections: the outer ear, the middle ear, and the inner ear. The parts are identified by their popular names when such names exist. In scientific language the shell is the *pinna*, the external canal is the *meatus*, the eardrum is the *tympanum*, the hammer is the *malleus*, the anvil is the *incus*, and the stirrup is the *stapes*. The whole of the inner ear is often called the labyrinth. How all this delicate machinery works is explained in the text.

follows the spiral outer edge of the cochlea from top to bottom and is filled with a fluid called endolymph. The hairs and the cells supporting them rest upon a threadlike tissue called the basilar membrane. This membrane is only a little more than an inch long, yet nearly 25,000 hair cells rest upon it, each topped with 10 to 15 auditory hairs. The basilar membrane is itself composed of microscopic fibers running crosswise and stretched taut like violin strings.

The combination of hairs, cells, and membrane in the cochlear duct is called the *organ of Corti*, after the man who first identified it. It carries out the ear's most delicate task. As the vibrations of sound from the perilymph pass through the wall of the cochlear duct and agitate the endolymph, they are analyzed by this organ of Corti. Here pitch and loudness are perceived.

Exactly how this takes place is not known. Many scientists believe that the fibers of the basilar membrane are progressively tuned, the short ones to high frequencies, the long ones to low frequencies. A musical chord would excite several groups of fibers at the same time. A loud sound would give a fuller vibration to the fibers than a faint sound. Whatever the pitch or loudness, the vibration of the basilar fibers is transmitted to their associated hair cells and the hairs in turn generate nerve impulses.

The Organ That Helps Us Keep Our Balance

We have explored the mechanisms of hearing and now we turn to the organ of equilibrium. It lies at the very top of the inner ear, between the middle ear and the cochlea, and it consists of three looped ducts, called the semicircular canals, and two connecting sacs, the utriculus and the sacculus. All these are filled with endolymph.

Inside the utriculus and the sacculus are tiny chalky stones called *otoliths*, which are attached to the ends of sensitive hairs. As we lean over or tilt the head in any direction, the pull or pressure of these stones on the hairs sends to the brain impulses which automatically indicate the direction of motion.

The semicircular canals deal with rotary movements and act without the aid of otoliths. When we turn the head from side to side as in saying "No" or when we spin around as in a revolving chair, the liquid in these canals is set into motion and brushes against tiny hairs which report the direction of the motion to the brain.

The brain learns by experience to interpret these equilibrium messages correctly. Spinning around makes most people dizzy for a short time after they stop because the liquid in the canals continues to move, and the automatic adjustment in the brain reacts as if the body itself were still revolving. But professional dancers can whirl rapidly and stop abruptly without any sense of unbalance because the equilibrium centers in their brain have learned to interpret correctly the messages from the inner ear.

The Work of the Eustachian Tube

For the eardrum to vibrate properly, the air pressure must be the same on both sides. The pressure is equalized by the Eustachian tube. This passage from the throat keeps the middle ear cavity filled with air to match the outside air pressure against the drum. Most of the time the tube is closed, but it opens when we swallow or yawn.

Differences in pressure on the two sides of the eardrum cause a ringing and a sense of fullness in the ears. This may take place aboard an airplane or in a fast elevator, when the change of altitude alters the outside air pressure very rapidly. But the unpleasant feeling in the ears is readily relieved by swallowing.

Violent air waves from a near-by explosion may burst the eardrum if the Eustachian tube is closed. Artillerymen are taught to keep their mouths open wide when big guns are fired.

The air pressure in the middle ear is transmitted to the inner ear through the elastic membrane that covers the so-called "round window."

Hygiene of the Ear

In most cases the ears can take care of themselves, and all but the outer shell should be let alone. Excess wax or objects entering the ear should be removed by a doctor, as careless prodding may puncture the eardrum.

Violent nose blowing may force infection through the Eustachian tube into the middle ear. Middle ear infection may spread to the mastoid cells of the temporal bone and thence to the brain.

From middle age, the lever bones of the middle ear tend to stiffen. The inner ear and the auditory nerve, set deep in bone, rarely suffer damage. (*See* Deaf, Education of; *see also* Sound.)

OUR GLOBE *and Its* WONDROUS STORY

EARTH. The ancients used to speak of Mother Earth, and they worshiped this supposed mother as a goddess. Thus in a mistaken way they recognized the very foundation of our existence. None of us could live an instant without the Earth beneath our feet.

But giving us a footing is only a start upon what the Earth does for us. It provides soil and water, and these in turn provide food for all living things. The air, water, and soil of the Earth catch and hold heat from the Sun; without this we would all perish in the bitter cold of outer space. Even if we fly in an airplane, we still need the Earth. It holds together the atmosphere which holds the airplane up.

Men have always realized their dependence upon the Earth, and have wanted to understand it. In all ages they have wanted to know what the Earth was like in faraway places. They have asked where it came from, how big it is, what holds it together, how it got its water, plants, animals, air, and climate.

How Did the Earth Take Shape?

From the time of the earliest people we know about, men have tried to explain how the Earth took shape as a planet. Some of the earliest accounts are shown in drawings on the opposite page. In recent centuries, men have turned increasingly to science for knowledge about the Earth. Scientists have cleared up many riddles, but they are far from being able to answer all our questions. A review of what is known and thought by modern scientists about these problems will show how much still remains a complete mystery.

The "Nebular" and "Planetesimal" Theories

The first explanation in modern scientific terms was offered by the French mathematician and astronomer Pierre Simon Laplace at the end of the 18th century. Laplace had been impressed by the heavenly bodies called *nebulae*—great masses of glowing gas, seemingly much larger than the solar system (*see* Nebulae). He worked out a theory (called the *nebular hypothesis*) that the solar system was formed by condensation of a nebula. As it shrank, it was supposed to have left behind rings of gas, and these rings gathered together into planets. But most of the mass kept on condensing until it formed the Sun.

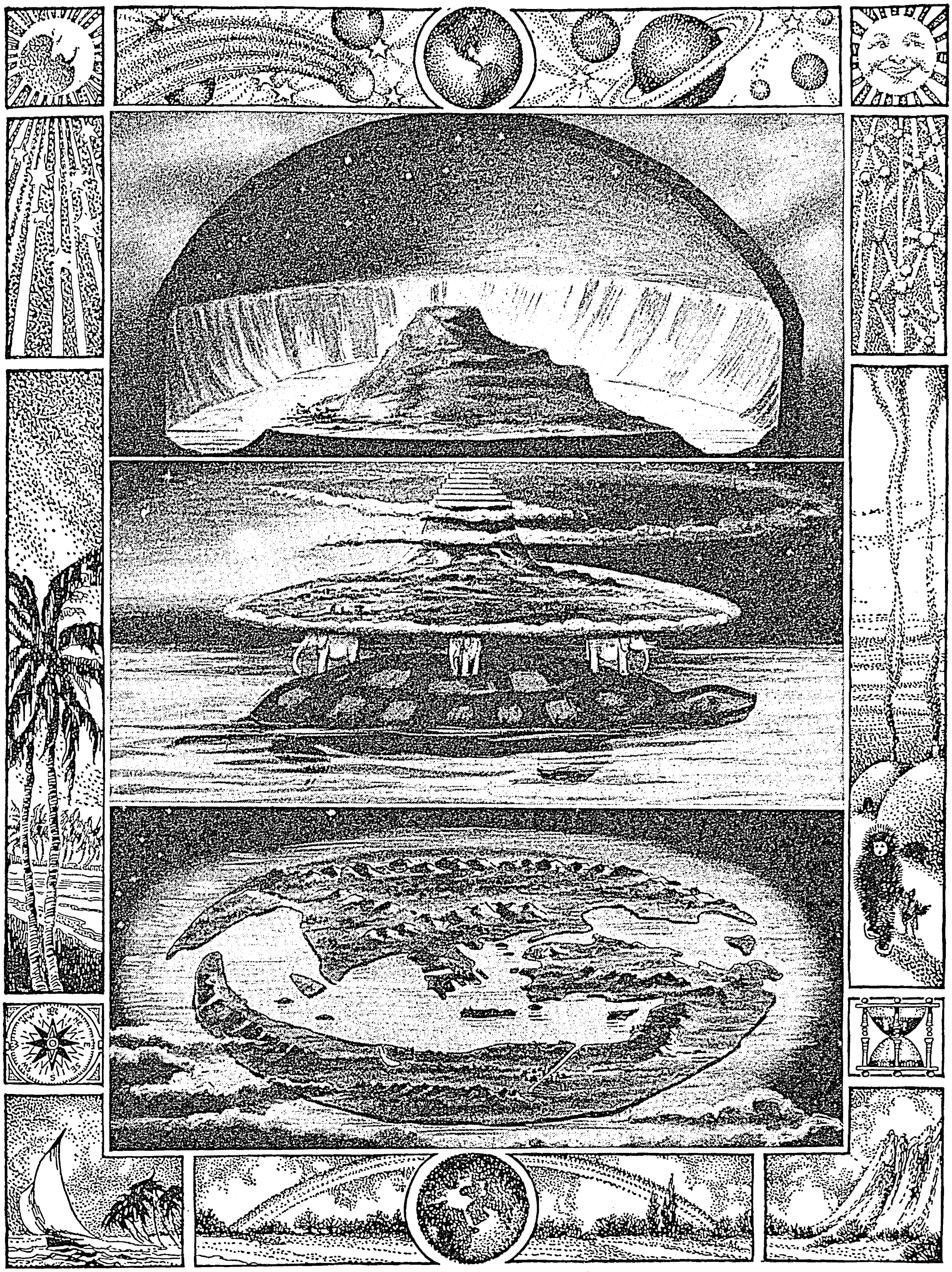
About 1900, Professors T. C. Chamberlin and Moulton of Chicago proved that this theory could not be true. In its place they suggested their *planetesimal hypothesis*. According to this theory, a giant traveling star passed by at some remote period, and its attraction drew out from the Sun great masses of matter which remained in the outer spaces. Gradually this matter gathered together into planets and their satellites.

Objections to this theory led Sir James Jeans and Harold Jeffreys of England to modify it considerably. (*See also* Planets.) But even the newest views leave many questions unanswered. Perhaps the most important one is, "If the Earth came from the Sun, where did the Sun come from?" Thus at bottom the question of how the Earth came to be is as much of a puzzle as it was in cave man times.

Geological History of the Earth

Geologists have done much to unravel the history of the Earth after its formation. They believe that at one time the Earth must have been a molten mass, and that its spinning shaped it into a ball. A crust of lava and other broken rocks formed upon it, and probably there were tremendous boilings and seethings of molten metal in all quarters of the globe. The Earth shook as the crust heaved and split and volcanoes threw out steam and gas and fire.

SOME ANCIENT IDEAS ABOUT THE EARTH



What a puzzle the earth has been to men! The picture above shows three of the fanciful ancient explanations of it. The top picture represents the old Chaldean idea, that the earth was contained inside a sort of chamber whose walls rose from the sea and whose ceiling was the arching sky. The middle picture shows the ancient Egyptian belief, that the earth rested upon four elephants which stood in turn upon a gigantic tortoise, swimming in a gigantic sea. The bottom picture shows the notion held by the older Greeks, that the earth was a flat disk, surrounded by the ocean.

One day in the history of these convulsions, the Moon may have broken off from the whirling Earth. In the late 19th century Professor George H. Darwin calculated that as the Earth cooled, it took the shape of a spinning pear, and then the tip of the pear flew off. If this did happen, it would have left a hole 27 miles deep in the Earth's surface. Professor Darwin suggested that this hole may now be the bed of the Pacific Ocean. One bit of geological evidence supports this idea. Over most of the Earth the outer crust contains considerable acid-type rock, such as granite; opposite types are found only at great depths and in some lava outflows. But over the entire Pacific Ocean no granite-like rock can be found. Perhaps it was all torn away and went to make up the Moon, as Professor Darwin suggested.

How Old Is the Earth?

How long ago all these things happened we can only guess, but many ingenious calculations have been made. The mud changed into rocks, the amount of salt in the sea, and the heat of the Earth have all helped man to guess the Earth's age.

Professor John Joly tried to find out the age of the Earth from the age of the sea. By calculating the rate at which the rivers carry salt to the sea, and estimating the total quantity in the sea, Joly reached the conclusion that it must have taken at least 90,000,000 years to carry that salt to the sea.

Sir Archibald Geikie, the geologist, tried to find out the age of the Earth by measuring the depth of the rocks that were made from mud deposited on the floor of the sea. He came to the conclusion that the rivers of the world could not have borne down the mud in less than 100,000,000 years.

Lord Kelvin, a great British physicist, tried to find out the age of the Earth from the time it must have taken the crust to cool, and he believed that about 100,000,000 years was as near the facts as we could get. Since the discovery of radium (*see* Radium), scientists have made different calculations based on the rate at which radioactive minerals break down. According to these calculations the Earth is somewhat more than one and one-half billion years old. Geologists believe this because they consider certain rocks in Manitoba, Canada, and in Karelia, north of Leningrad, Russia, to be among the oldest known; and the proportion of radioactive minerals found in them would take about one and one-half billion years to form.

This age is vastly greater than any figure obtained by older calculations; but geologists explain this readily. They say the older calculations assumed that everything happened only once. Lord Kelvin, for example, assumed that when the Earth lost its original store of heat from the Sun, it would be cold forevermore. But radioactivity provides heat enough to keep the Earth warm almost indefinitely. The other "short-age" calculations, like Joly's calculation based upon sea salt, are explained away by claiming that the surface of the Earth was made, not once, but several times. Calculations such as Joly's can only use evidence from the later reshapings, and cannot be trusted to reveal the full age of the Earth.

How Will the Earth End?

In time the Earth, like the Moon, will cease to spin, and one-half of its surface will be in perpetual darkness and the other half in perpetual light. Even before then the Earth may go the way of Mars and lose the water without which life as we know it cannot exist.

In any case, we need not trouble overmuch about such things as these, for life is humanly certain upon the Earth for millions of years to come. Certain it is that the Earth has not yet reached its final state, for the story of these changes still goes on. The Earth is still being made today, not less than when the twistings in the red-hot globe were forming the ocean depths. Nothing is at rest. All things move with time and tide. The very mountains are crumbling into dust, while new mountains are rising unnoticed by us, and ocean depths rise slowly from the sea.

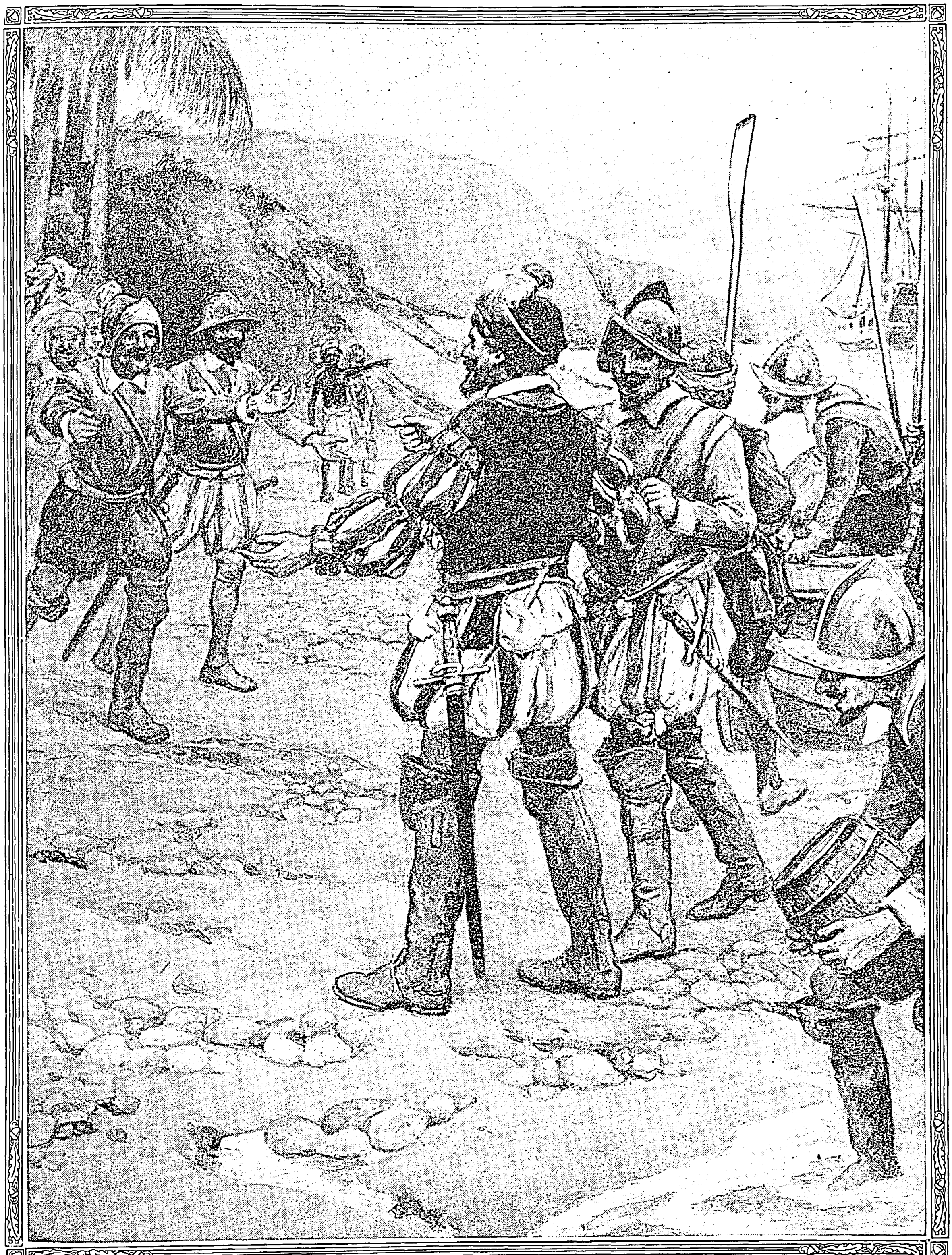
Description of the Earth

Of the nine principal planets that revolve about the Sun, the Earth ranks sixth in size. It is the third planet nearest the Sun, its mean distance from the Sun being about 93,000,000 miles (*see* Planets; Sun and Solar System). Men have held many views regarding the shape of the Earth. Even up to 1522, when a vessel of Magellan's completed its circumnavigation of the globe, the theory of a flat Earth had many adherents. Well-informed scholars of all historic times, however, have presented sound evidence that the Earth is round. The Greek astronomer Eratosthenes, 250 years before Christ, not only taught that the Earth is spherical in shape, but roughly calculated its circumference. He did this by noticing that on the same day when the sun shone straight down into a well at Syene, Egypt, it was 7.2° south of the zenith at Alexandria, 500 miles north of Syene. From this he calculated the curvature of the Earth. If we can estimate his Greek measurements correctly, he came within a few hundred miles of estimating the true circumference.

Each of the following tests supports the theory of a round Earth: (1) During a lunar eclipse the shadow of any face of the Earth cast on the Moon's surface is circular in outline. (2) If we stand on the shore and watch a ship move out over the sea, the hull of the ship will disappear first and the top of the mast or funnel will sink below the horizon last. (3) People living in Australia and other parts of the Southern Hemisphere cannot see the Pole Star, the Great Bear, or Orion; nor can people living in Canada see the Southern Cross. On a flat Earth any star or constellation visible from one point could be seen from any other. (4) The principal characteristic of a sphere is that the surface curvature is equal on all parts. Measurements show that this is essentially true in the case of the Earth.

Strictly speaking, the Earth is not a perfect sphere, but approaches the form of a perfect *oblate spheroid*

WHEN EAST MET WEST IN 1521



Although men of science had long been convinced that the earth is a globe, the first undeniable proof of its roundness to the popular mind came when men traveling eastward around the earth met others who had traveled westward. This historic event took place in 1521 on the island of Tidore in the Malay archipelago. The Portuguese had established themselves there several years before, after sailing around Africa; and members of Magellan's crew met them after sailing around South America.

Just as the centrifugal force produced by a revolving wagon wheel causes the mud to fly away from the rim, so too the centrifugal force produced by the Earth's rotation causes the material about the equator to bulge outwards. Consequently the Earth is somewhat flattened at the poles, and its equatorial diameter (7926.69 miles) exceeds its polar diameter (7899.98 miles) by nearly 27 miles. For all but exact calculations, the circumference is taken as 24,000 miles.

The mean density of the Earth as compared with water is about 5.51. The surface density is only about 2.75, and since this is much less than the average for the entire Earth, the density at the Earth's center must be much greater than 5.51. Weighing our planet is another stupendous task that has been accomplished with great accuracy. The most recent determinations are those made in 1930–31 by Dr. Paul R. Heyl of the U. S. Bureau of Standards. By means of the torsion balance or pendulum, Heyl found that the Earth weighs approximately 5.97×10^{27} grams, or about 6,592,000,000,000,000,000,000 short tons (*see* Pendulum). The gravitational attraction of this tremendous mass keeps the Moon, the Earth's only satellite, in its orbit around the Earth (*see* Gravity; Moon).

It has long been known that the Earth is one huge magnet, with a north magnetic pole at a point 70° 5′ north latitude and 93°43′ west longitude; and a south magnetic pole about 72°25′ south latitude and 155°16′ east longitude. But there is a slow change in the location of these magnetic poles, the belief being that the magnetic axis is rotating about the geographical axis once in about 1,000 years (*see* Compass; Magnet).

The Earth consists of three main parts. The vast solid body is called the *lithosphere* (from the Greek word *lithos*, meaning stone, and *sphaira*, meaning globe or sphere). Sometimes the term lithosphere is used to designate only the outer crust of the solid Earth. The very dense central core is then termed the *centrosphere*, and the more plastic layer between the exterior crust and the inner core is called the *asthenosphere*. The lithosphere is covered and slightly penetrated by the *hydrosphere*, or sphere of water, consisting of all the oceans, lakes, ponds, springs, and streams, and covering about 70 per cent of the Earth's surface. The blanket of gases and vapors that envelops the lithosphere and hydrosphere is the *atmosphere* (*see* Air).

The continental masses and ocean basins are irregularities in the outer crust of the lithosphere. The mean depth of the ocean basins is about $2\frac{1}{2}$ miles (13,000 feet); the mean height of the continents above sea level is about 2,400 feet. These irregularities of the Earth's surface are trifling when compared with the size of the Earth, which is nearly 8,000 miles in diameter, or 2742 times the difference between the high and low mean levels of the surface.

The Theory of Isostasy

Isostasy (from the Greek word, meaning equal standing) is a term applied to the theory that the crust of the Earth is relatively balanced in weight and pressure throughout. This means that where mountains and higher lands exist, the prism between these surfaces and the center of the earth must contain, on the whole, materials less dense than those in the prisms underlying depressions such as those of the sea bottom. The theory claims that the Earth is always trying to bring itself into isostatic equilibrium. As erosion carries matter from the land to the sea, the increased weight on the ocean bottom is balanced by the upthrust of lighter materials elsewhere.

The Earth's Motions in Space

The Earth's movements as a planet may be considered in two groups: those relating to its movements in its orbit around the Sun, and those relating to its rotation on its axis. Connected with the latter are the important phenomena arising from the fact that the axis is tilted, as will be explained later.

The orbital motion can be detected by the fact that from month to month the Sun seems to move eastward among the stars, until in the space of a year it has moved all around the heavenly sphere to its starting point. Measurements indicate that the orbit is about 583,825,765 miles in circumference, and the Earth must travel at a mean speed of about 18.5 miles a second to complete the circuit in a year. On the average, the Earth is 93,000,000 miles from the Sun, but this distance varies because the orbit, instead of being circular, is an *ellipse*, with the Sun at one of its foci. The Earth reaches the point on its orbit that is nearest the Sun about January 1. This point is called the *perihelion*, from *peri*, meaning near to, and the Greek word *helios*, meaning Sun. About July 1 the Earth reaches the *aphelion*, the most distant point on its orbit from the Sun. It is then 3,000,000 miles farther away from the Sun than it is at perihelion. Sometimes either the perihelion or the aphelion is referred to as an *apse* or *apsis* (from the Greek word *hapsis*, meaning wheel). The line passing through these two points is called the *line of apsides*.

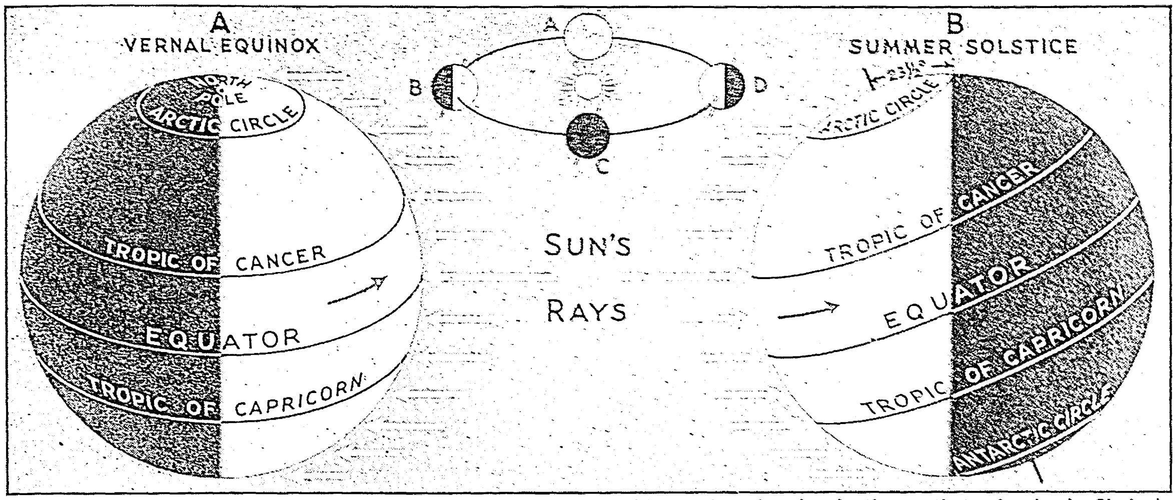
In the course of its journey around its orbit the Earth itself has performed 365.2422 axial rotations relative to the Sun; that is, we have had 365.2422 days and nights. Since it is not convenient to use fractions on our calendar, we make a year into 365 days, and then catch up with time by making a leap year of 366 days every fourth year (*see* Calendar).

The Earth's Rotation on Its Axis

Daily we may see the Sun and stars, which are near the plane of the Earth's equator, rise in the east, journey across the celestial sphere, and set in the west. The diurnal (daily) motion of these celestial bodies might be explained in two ways: first, that the Earth is stationary and the Sun, stars, and other bodies circle about it, and second, that the Earth moves or rotates on its axis from *west to east*, while the Sun and stars remain fixed. This rotation causes day and night.

A simple and sound proof that the Earth rotates was given by the French physicist, Jean Foucault, in 1851, although this view was established long before his time. In the high tower of the Panthéon in Paris he suspended a heavy iron ball from a fine wire more

WHY SUMMER COMES BUT ONCE A YEAR



These pictures show how the movement of the Earth in its orbit and the inclination of its axis together cause the seasons. The poles always have the same slant. Hence when the Earth is at position (A) in its orbit the poles are equidistant from the Sun. The larger picture A shows the Earth at this moment, except that, in order to show the Sun's rays on the page, the north pole slants toward us, instead of to the right. You can see how every portion of the Earth has 12 hours of daylight and 12 hours of night at this time—hence the name *vernal equinox*. Notice how the Sun's rays strike the equator from directly overhead, and at more and more of a slant as you look to the north or south. Three months later the Earth will be at position (B), called the *summer solstice*, in its orbit. (In the larger picture B of the Earth at this time, the position of the pole is again altered for convenience in illustration.) Now notice how the Sun's rays strike the Earth. Because of the 23½ degree slant of the Earth's axis, every point between the north pole and a line drawn around the Earth 23½ degrees from the pole, will have sunlight the entire 24 hours. The limit of this zone is called the *Arctic Circle*. Also notice that the Sun's rays now strike the Earth from directly overhead, not at the equator, but at points along a line 23½ degrees north of the equator, called the *Tropic of Cancer*. You can also see, from the shadowing, how every point north of the equator will have more hours of direct sunlight than of darkness. South of the equator, this is reversed, until all points within the *Antarctic Circle* (corresponding in the south to the Arctic Circle in the north) are in darkness the entire day. The northern hemisphere also receives more heat from the Sun, and has summer, while the southern hemisphere receives less heat, and has winter. Three months later, the Sun passes through its *autumnal equinox* (C), the reverse of the vernal equinox—and three months after that comes the *winter solstice*, when everything inside the Arctic Circle is in darkness, the entire zone inside the Antarctic Circle has 24 hours of daylight, and the Sun's rays strike from directly overhead on the *Tropic of Capricorn*, corresponding in the south to the Tropic of Cancer in the north. These names came from the fact that the sun was in these "houses," or signs of the zodiac, when the respective solstices occurred in ancient times.

than 200 feet long. According to the laws of physics, a pendulum like this, if undisturbed, will swing for several hours in the same plane. A pin fastened to the bottom of the pendulum cut a mark in a heap of sand placed directly beneath it, at every swing. If the Earth were stationary, the pin would continually touch the sand in the same spot, but Foucault discovered that a fresh cut was made at each swing. This indicated that the floor of the building along with the Earth was gradually turning under the pendulum.

The Earth spins around on its axis at nearly a constant speed. The time required for it to make one complete rotation relative to the stars is 23 hours, 56 minutes, and 4.095 seconds. This period is called a *sidereal day*. Because it has moved along its orbit meantime, it takes the earth about four minutes longer to complete a rotation relative to the Sun (a *solar* day), the time being about 24 hours. (*See* Time.)

The Important Tilt of the Axis

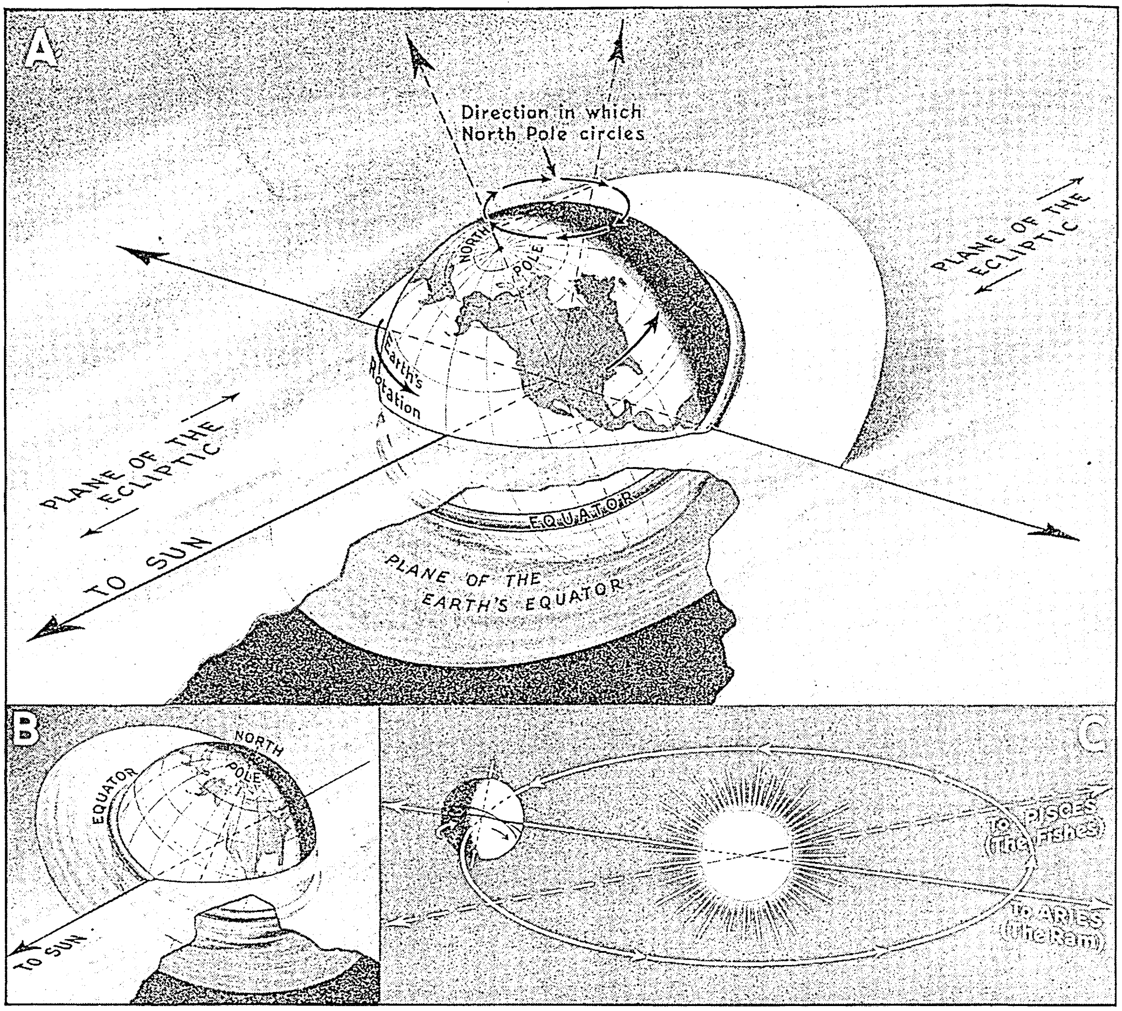
Change of seasons and change in the length of day and night are caused by the Earth's axis tilting 23½ degrees from a vertical position relative to the "plane of the ecliptic." This plane is the plane of the Earth's orbit, and the imaginary line where it passes among the stars is the *ecliptic*. The tilted axis always remains parallel to itself. Therefore at times the north pole is inclined toward the Sun and the south pole is inclined away from the Sun, thus causing summer in the northern hemisphere and winter in the southern. Six months later the reverse is true; while midway between, when the poles are equally distant from the Sun, occur spring and autumn (*see* Equinox and Solstice). The seasonal temperatures are developed after the Earth has passed these seasonal points in its orbit, because it takes time for each hemisphere to gain or lose heat. The accompanying picture makes all this plain, and also explains the Arctic and Antarctic circles, and the Tropics of Cancer and Capricorn.

Because the zone between the two Tropics is always under more or less direct rays from the Sun, it never gets cold, save on mountain tops, and hence is called the *tropical*, or torrid, zone of the Earth. The zone between each pole and its circle never gets much strong sunlight, with accompanying heat, and therefore each one is called a *frigid* zone. Between the frigid zones and the tropical zone, lie the north and south temperate zones, which do not get very hot or very cold, and which have marked seasonal changes. Each temperate zone is 43 degrees in width from north to south. In addition to the equator, the Tropics, and the circles, geographers describe locations by means of imaginary lines called *meridians* of longitude and *parallels* of latitude (*see* Latitude and Longitude).

The Curious "Precession of Equinoxes"

The tilt of the Earth's axis causes another curious phenomenon, called the "precession of the equi-

ODD RESULTS OF THE EARTH'S SLANTING AXIS



Although, as the text explains, the Moon, acting on the Earth's slanting axis and equatorial bulge, has three times as much effect in causing precession as the Sun, the effect of the Sun alone will be considered here, because we think of precession as related to solar equinoxes. The large diagram (A) showing the principle of Newton's explanation of precession, portrays the Earth at summer solstice for the northern hemisphere. At this time the plane of the Earth's equator, extended into space, will lie as shown. Now imagine a second plane, called the "plane of the ecliptic," passing through the centers of the Sun and the Earth. The two planes will intersect along the lines marked. Now imagine, as Newton did, the "equatorial bulge" of the Earth concentrated into a ring around the equator, on an otherwise spherical earth. The Sun's pull will try to draw this ring up into the plane of the ecliptic on the nearer side, and down on the farther side, so that the ring will lie in the plane. But since the Earth is spinning, it has the properties of a giant gyroscope, and it responds to this pull just as a gyroscope would. That is, the north pole, instead of rising to an upright position, will describe a circle in the direction marked. Because the "righting effect" of the Sun's pull, in comparison with the Earth's mass, is very slight, the pole's motion is extremely slow, one circle being made in slightly more than 25,800 years. As the pole circles, it will, of course, point to different stars as the "north star," returning to each one 25,800 years later. The remaining diagrams show other consequences of this wobbling. In (B) we see the Sun, not at solstice as in (A), but at equinox. This occurs at only two instants, six months apart, in any year, the instants being those when the north and south poles are at the same distance from the Sun. You will notice that the line along which the planes of the Earth's equator and the ecliptic intersect now also joins the centers of the Earth and the Sun, and is called "the line of the equinoxes." At the instant of equinox, observers on the "night" side of the Earth could identify some point in the heavens which this line, prolonged, would strike. Similarly, if the sun were blotted out, an equinoctial point could be identified in the heavens from the "day" side. The point would be in some sign of the zodiac, and the ancients said the Sun was in that "house," the house in their days being the sign of Aries, the Ram, at the vernal equinox, as in (C). Now consider what happens at the equinox a year later. The Earth's pole has moved during the year, so that when the intersection of the planes comes into line with the centers of the Earth and the Sun, it does not point to the same places in the heavens as before, having shifted a bit forward in the direction of the Earth's orbital movement. The shift is very slight in any one year, but it has been enough since ancient times so that the Sun now is in the "house" of Pisces, the Fishes, at vernal equinox.

noxes"—the slow change in the apparent position of the Sun in the heavens at the equinoxes (*see* Equinox and Solstice). The article on Gyroscope explains in detail the principle of precession. Every spinning body, from a toy top to a great planet, is subject to precession whenever any outside force tends to tip its axis out of line. Instead of tipping, the spinning body merely wobbles around its center of gravity in such a way that the ends of its axis make circles.

Picture the Earth as a huge top spinning on a tilted axis; and think of the pull of the Sun and of the Moon as forces that are constantly trying to straighten up that axis. The drawing and text on the opposite page give the reasons for this action so far as the Sun is concerned. The influence of the Moon, because of its nearness, is twice that of the Sun.

Besides its effect on the equinoxes, this slow circular "wobbling" movement of the Earth's poles causes the North Pole to point in succession to different "north stars." It now points to Alpha of the Little Bear or Dipper, but is gradually moving toward Vega. Six thousand years ago it pointed more nearly to Alpha Draconis. Newton was the first to explain the Earth's precession.

A variation in the regularity of the Earth's precession is caused by the fact that the angle of the Moon's pull differs by five degrees from the angle of the Sun's pull. This variation is called *nutation*.

WHY *and* WHERE EARTHQUAKES *Take* PLACE

EARTHQUAKE. To understand earthquakes, we must have in mind the general makeup of the earth's crust. This crust, estimated to be about 50 miles thick, is composed of blocks or slabs of rocky material, lying in irregular layers and piles. To get an idea of its pattern, think of a city dumping ground with its heaps of masonry, bricks, tiles, slate, mortar, and stone that have been carted away from wrecked buildings and have gradually been packed down more or less solidly. Just as the material on the dumping ground will show some traces of regularity because of the order in which the various kinds of materials were dumped, so the pattern of the earth's crust shows traces of its original structure and makeup.

The earth's crust as we find it today represents the wreckage of the far more even and orderly surface that existed billions of years ago. Shrinkings and swellings in the interior of the earth, and in the crust itself, caused the crust to crack and buckle. Great layers of rock split off and slid over one another; some tilted up and stood on edge forming mountains; others were ground and squeezed into small fragments (*see* Geology; Rock).

As time went on, the tremendous upheavals that changed the entire face of the earth diminished and the fragments of the crust settled down into more or less permanent position. Here and there, however, areas of rock were left imperfectly supported or out of balance, ready to slip or crack if disturbed in any way. The disturbance may be due to further shrinking, to pressure from below, to volcanic explosions, or to the additional weight of loose material piled above that area by the action of water. Whatever the cause, if the movement in the rock area is sudden, it produces an earthquake or "temblor." The movement may consist of a slip along an old crack or "fault," or it may result in new faulting in the crust.

As we would expect, the conditions that produce earthquakes are more likely to be found where the crust of the earth remains most uneven; that is, in regions where high mountains exist near very low areas. The low areas may be dry land valleys or they may be great "deeps" in neighboring oceans.

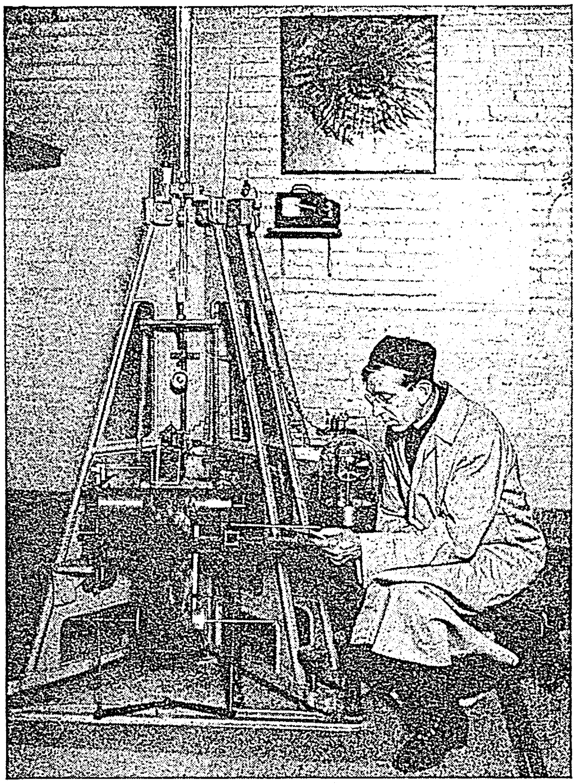
If we examine a map showing heights and depths the world over, we can easily pick out the most conspicuous of these regions. They lie along the Pacific coasts of North and South America west of the Great Basin, and along the eastern coast of Japan. They include the islands of the East Indies, the West Indies, and the middle Pacific, which are the tops of great mountain ranges rising from the ocean beds. Others lie along the southern edge of the Himalaya Mountains and along the mountainous promontories—Italy and Greece—that jut southward into the Mediterranean Sea.

These and similar regions make up what geol-

WHEN THE EARTH "OPENS"

One of many fissures produced by an earthquake near Three Forks, Mont., in 1925. It was 100 feet long and 8 feet deep in places. It is typical of the effect of a quake on loose soil.

A SEISMOGRAPH OR QUAKE DETECTOR



This seismograph at Georgetown University illustrates the principle that governs most of these instruments. The frame, with the recording drum attached to it, rests on a cement foundation extending down to bed rock so that it can pick up distinctly the vibrations in the earth's crust. In the angle of the frame hangs a heavy pendulum. By the law of inertia this pendulum will remain stationary even though the frame from which it is suspended moves back and forth slightly. Thus, when an earthquake vibration comes along, the frame and drum move with it, but the pendulum does not. The slight difference in motion is magnified by an electric relay system and traced by a needle on the roll of smoked paper which revolves around the drum. The picture below shows one of these tracings.

ogists call the "earthquake belts." They also contain most of the world's active volcanoes (*see* Volcanoes). About 8,000 earthquakes are recorded each year the world over. Japan has an average of about three a day, most of them slight. Most earthquakes do no damage. Even during violent quakes the solid crust of the earth usually moves very little—from half an inch to 2 inches horizontally. But, as a result, loose overlying soil may shift 20 feet or more. Then fissures are likely to open on the surface; buildings standing on the shifting areas will tumble down and water mains, gas pipes, and electric cables will be broken, with the added danger of fire, as in the San Francisco earthquake in 1906.

Quakes Beneath the Ocean

Submarine earthquakes sometimes cause huge waves that carry destruction far inland. In the Lisbon earthquake of 1755, waves 60 feet high drowned many thousands within a few minutes. At Arica on the west coast of South America in 1868 war vessels were carried two miles inland by an earthquake wave. Small islands are at times swallowed up during earthquakes.

Permanent changes in land levels sometimes result from earthquakes, as happened near New Madrid, Mo. in 1811–12, where new marshes and lakes were created.

Two types of construction have been developed which permit buildings to withstand earthquakes. Small dwellings are made of light framework which can rock and shift without coming apart. In heavier structures of steel and stone supporting members are placed beneath the middle instead of beneath the ends of the cross beams, so that the latter can move considerably out of line without slipping off their supports and allowing floors or roof to collapse. (*See* Japanese Art and Architecture.)

The area of most violent movement, which is supposed to lie immediately over the point in the crust where the earthquake originates, is called the *epicenter*. From this area, shocks and vibrations of diminishing force radiate in all directions. By measuring these vibrations with instruments called *seismographs* (*sīs′mō-grăf*) or *seismometers* at various points on the earth's surface, it is possible to locate fairly accurately the center or focus of the disturbance. The working principle of these instruments is described with the accompanying illustrations.

Seismology, or earthquake science, gives us our most reliable information about the makeup of the earth's interior, by measuring the speed with which vibrations travel through it. It is important also in engineering. By studying the character of shocks, engineers are able to construct dams and pipe-lines that will withstand them. One reason why the United States chose to run a canal across the Isthmus of Panama rather than across Nicaragua was that the former site is somewhat freer from earthquakes than the latter.

Some Notable Earthquakes

1755. Lisbon, Portugal. Sea wave produced by quake destroyed the city with loss of about 40,000 lives.

1811–12. New Madrid, Mo. Reelfoot Lake in Tennessee and Kentucky formed by the sinking of a part of the flood plain of the Mississippi.

1886. Charleston, S. C. Twenty-seven lives lost, 14,000 chimneys shaken down, and locomotives derailed. The shock was felt over a very great area.

1891. Mino and Owari, Japan. Killed, 7,279; injured, 17,393; wholly destroyed, 197,000 houses.

1897. Bengal and Assam, India. Thirty lakes produced by tremendous changes in ground level.

1906. San Francisco, Calif. Violent quakes, accompanied by surface movements ranging up to 23 feet, followed by fire; about 700 killed; property damage, $200,000,000.

1908. Calabria and Sicily. About 76,000 persons killed, 95,000 injured; most of Messina and surrounding villages destroyed.

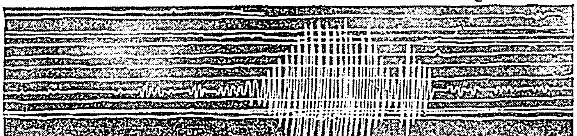
1915. Central Italy. About 30,000 lives lost and 372 towns and villages damaged.

1917. Guatemala. Repeated earthquakes over a week's period killed about 2,500 persons.

1920. Orizaba, Mexico. A score of villages and towns damaged and about 3,000 persons killed.

1920. Kansu Province, China. Violent quakes ranging over 300 square miles; 200,000 lives lost.

THE SIGNATURE OF AN EARTHQUAKE



The soot-covered paper ribbon rolls by under the needle, producing straight lines until the sudden vibration from a distant earthquake sends the needle zig-zagging in wide side strokes.

1923. Tokyo and Yokohama, Japan. One of the severest quakes in history; nearly 160,000 killed and both cities wrecked.

1929. Khorassan District, Persia, and Russian Turkestan. Widespread quakes caused the death of about 2,000 persons.

1929. Newfoundland. Quake off southern coast produced waves 100 feet high; 26 drowned; 12 ocean cables broken.

1931. North Island, New Zealand. Destruction along 45 miles of coast; Napier harbor bed rose 18 feet; 250 killed.

1934. Bihar and Orissa Province, India. About 7,000 killed; 400,000 lost livelihood from sand spread over fields.

1935. India. Cities of Quetta, Kalat, and Mastung destroyed; floods gushed from fissures; 30,000 dead.

1939. Chile. Fertile central valley devastated; Concepción, Chillán, other cities wrecked; 25,000 killed.

1939. Turkey. A region extending 200 miles inland from Black Sea ruined; 45,000 killed in shocks and after-blizzard.

EARTHWORM. The earthworm is nature's plowman, ceaselessly at work turning over and loosening the soil, letting in air, making it more permeable to water, and more fertile. Charles Darwin estimated that an acre of garden averages about 53,000 worms, through whose bodies some ten tons of soil pass every year.

Some South African and Australian species of earthworms reach five feet in length, though American species are rarely a foot long. The surface of the earthworm's body is provided with tiny bristles which aid in crawling and in burrowing. Furrows divide the body into a number of rings; those in front are larger than those in the middle and those behind are flatter, so that one easily tells the head-end and the tail-end.

Although to general appearances the earthworm is so low in the scale of life, it is wonderfully constructed, and is provided with organs of digestion, circulation, nervous life, and others. The digestive system is a muscular tube running all through the body, having a crop and gizzard in its course; the front end of it is capable of being thrown out and drawn in by a set of muscles. The food consists of animal and vegetable matter mixed with the soil, for example, minute fragments of old leaves.

By the action of a group of suction muscles, the earthworm fills its alimentary tube with earth in which are scattered particles of animal and vegetable matter. The food passes into the crop for storage. From there it is taken into the gizzard for grinding with the aid of tiny grains of sand that are swallowed for that purpose. Then the food is digested and absorbed into the system and the earth is voided again. In this way these worms work the soil over. They also bring vegetable mold to the surface, and bury objects thrown upon the ground, at the rate of two inches or more in ten years.

Each of the 92 body rings of the earthworm contains a tiny pair of kidneys. The center of its nervous system that serves as its brain is small, but its nervous reactions are extremely sensitive. Though it has no eyes, it can distinguish readily between light and darkness. It recognizes also sounds and odors. These reactions can be traced to certain "sense-cells" on the surface of its body.

Though each worm is at once male and female, earthworms pair to fertilize their eggs. Near the front of the earthworm's body is a swelling called the "saddle." Here a case or *cocoon* forms, encircling the body and in it the microscopic eggs are laid. When they hatch out in about two weeks the young are less than an eighth of an inch long. It takes about two years for them to reach their full growth.

EARTHWORMS HUNTING NEW HOMES

When you walk out some wet morning and find numerous earthworms on the surface of the ground, you may know that they are traveling to better feeding grounds. They have probably not been "drowned out," as is commonly supposed.

During the warm and mild parts of the year the worms spend their lives within 12 or 18 inches of the surface. They form burrows into which they are able to retreat when the soil is soaked with rain. To keep out the water they block the openings of their burrows with bits of leaf or other available material.

When the place where they live becomes overcrowded with their own kind, earthworms migrate. They wait for a damp or rainy night, come to the surface, and crawl considerable distances in search for a new home. Their greatest danger then is that the sun will rise on them while they are crossing some surface into which they cannot dig, for then their skins may become dry and they perish.

If the soil in which an earthworm is living dries up, the worm coils up and forms with the aid of moisture from its own body a sort of mud cell around itself until the next rain. In the winter time worms crawl down below the frost line and hibernate.

Birds and moles are their principal living enemies. When a robin tugs at a worm, however, and breaks it in two, this does not always mean the worm's death. Earthworms have the extraordinary ability, after losing considerable sections from head or tail, of growing new ones.

There are about 90 species of earthworms in North America, mostly of the genus *Lumbricus*. Many related species exist in fresh and salt water. (*See* Soil; Worms.)

EAST AFRICA. The region which we call East Africa includes the Uganda Protectorate, Kenya Colony and Protectorate, the islands of Zanzibar and Pemba, the mandated territory of Tanganyika, and Nyasaland Protectorate—all under British control. In the broad sense it also includes Mozambique, or Portuguese East Africa, which, however, both politically and geographically, is better considered as a separate unit (*see* Mozambique). Livingstone, Stanley, and other great explorers of the last century blazed the trail for British colonization in this part of Africa, which was followed eventually by British control. (*See* Livingstone, David; Stanley, Sir Henry Morton.)

BRITISH EAST AFRICA

Kenya Colony and Protectorate: Area, 224,960 square miles; population, about 3,000,000 including 50,000 Asiatics and 17,000 Europeans; capital, Nairobi (47,000); chief port, Mombasa (50,000).

Nyasaland Protectorate: Area, 37,600 square miles; population, about 1,600,000, including 1,500 Asiatics and 1,800 Europeans; capital, Zomba.

Tanganyika Territory: Area, 360,000 square miles; population, about 5,000,000, including 35,000 Asiatics and 8,000 whites; capital and chief port, Dar-es-Salaam (30,000).

Uganda Protectorate: Area, 94,000 square miles; population, about 3,500,000, including 15,000 Asiatics and 2,000 Europeans; native capital, Kampala; British capital, Entebbe.

Zanzibar and Pemba: Area, 640 and 380 square miles, respectively; population, about 245,000, including 14,000 British Indians, 34,000 Arabs, and 300 Europeans; capital, Zanzibar (45,000).

East Africa is a vast plateau with an average elevation of about 4,000 feet and with a number of mountain peaks, including the two highest in Africa—Mount Kilimanjaro, 19,710 feet, and Mount Kenya, 17,140 feet. The plateau is broken by a series of troughs known as the Great Rift Valley, extending for the most part from north to south and marked by a chain of lakes, the northernmost of which is Lake Rudolf and the southernmost, Lake Nyasa. Tanganyika (*see* Tanganyika, Lake), one of the deepest lakes in the world, lies in a branch of the Rift Valley to the west, which also contains Lake Edward and Lake Albert. Between the two branches is Lake Victoria, the second largest fresh-water lake in the world (*see* Victoria Nyanza).

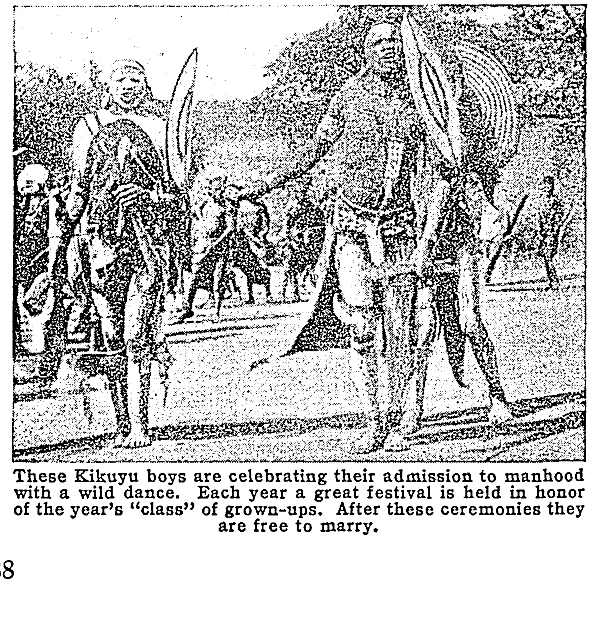
Although no part of East Africa is more than 18 degrees from the equator, the climate is moderated by the high altitude. The days are fairly hot, but the nights are cool. Rainfall is moderate, but well distributed. Neither heat nor humidity is so great as in West and Central Africa, and consequently the climate is much less oppressive. Nevertheless the constant warm weather is trying to most Europeans.

Kenya, though crossed by the equator, has, in its high inland plateau a more favorable climate than has most of East Africa. It contains the most famous hunting grounds of East Africa, as well as the richest farmlands. The chief gateway to all East Africa is the old port Mombasa, established by Arab and Portuguese traders centuries ago. It is built on an island and on the adjoining mainland. East Indian, Arab, and European merchants mingle here with the black-skinned natives of the Swahili tribe, whose language has become a common tongue all through the East African region. A railway, which extends into Uganda, connects Mombasa with Nairobi, Kenya's capital, famous as the outfitting point for big-game hunters.

Kenya, with an area considerably larger than that of California and altitudes varying from sea level to more than 9,000 feet, has a wide variety of products. Wheat and corn thrive on the central plateau; coffee, tea, sugar, cotton, and sisal in the area around Lake Victoria; and coconuts, sisal, and cotton in the coastal region. The native Bantus work the large farms of the white settlers, and also have farms of their own.

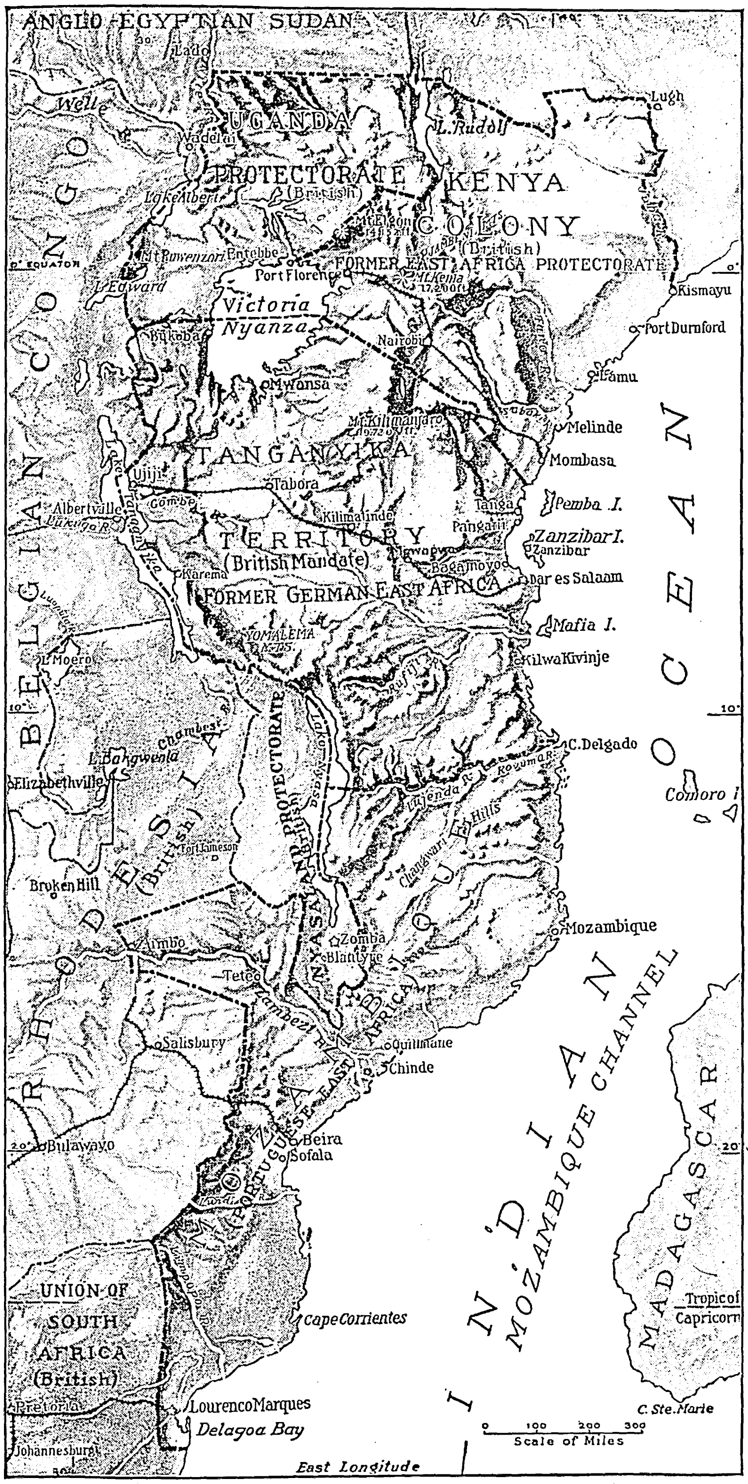
Kenya has large deposits of natural soda on and around Lake Magadi, not far from Nairobi, and in 1932 a rich and extensive gold field was discovered northeast of Lake Victoria. The territory has a considerably larger proportion of Europeans than has any other part of East Africa. The settlement of the whites, however, has brought serious problems. Not only have the natives been deprived of much of the best land, but in many instances their tribes have been disrupted. Among those who have suffered are the Kikuyu, a Bantu people who have brought the land to a good state of cultivation, and the Masai, a nomadic pastoral people of mixed Negro and Hamitic stock. Kenya is a British crown colony, except for Kenya Protectorate, a strip of coastland leased from the Sultan of Zanzibar. The islands of Zanzibar and Pemba also constitute a British protectorate (*see* Zanzibar).

A TRIBAL CEREMONY IN EAST AFRICA



These Kikuyu boys are celebrating their admission to manhood with a wild dance. Each year a great festival is held in honor of the year's "class" of grown-ups. After these ceremonies they are free to marry.

WHERE CIVILIZATION MAKES RAPID PROGRESS



The vast region shown on this map is the scene of a thrilling struggle between the forces of civilization and the forces of savagery, in which civilization is rapidly getting the upper hand. Under British control, East Africa is slowly being turned into farmland. The lion and the leopard are giving way to the plow and herds of domestic cattle. You can see here how Great Britain's dream of possessing a solid strip of territory from the Union of South Africa to Egypt was realized by the annexation of the former German colony, following the World War.

The Uganda Protectorate is administered by Great Britain, but the native chiefs and kings are allowed considerable authority. Unlike Kenya, Uganda is a black man's country. Land may not be sold to non-natives, except by special permission of the governor, and this is rarely granted. The highly intelligent Baganda are the leaders among the people. Their language, the Luganda, is used in the schools, which are maintained partly by the missionary societies and partly by the British government. There is a University College at Kampala for the higher education of the natives. Uganda is the chief cotton-producing country in East Africa. Nearly all of the cotton is grown by natives without the supervision of Europeans, and is exported to India by Indians, who carry on most of Uganda's commerce. For food the Baganda depend largely on bananas and millet. Cattle, sheep, and goats are raised in the semi-arid districts.

Tanganyika Territory is the former German East Africa. British and Belgian forces conquered it in 1918 and (except for a small district in the northwest which went to the Belgian Congo) it was assigned to Great Britain under a mandate from the League of Nations. This territory, larger than Germany and Italy combined, has about 500 miles of coast line. Dar-es-Salaam, the capital and the chief port, has an excellent and well-sheltered harbor. From this city a railroad crosses to Kigoma just north of Ujiji on Lake Tanganyika. As in Uganda, trade is chiefly in the hands of Indian merchants. The greater part of the interior is too dry for agriculture, but provides excellent pasturage for great herds of cattle, sheep, and goats, owned mostly by the natives. By far the most important export is sisal, which is grown along the coast. This fiber plant was recently introduced from Mexico; it is cultivated on plantations owned by Europeans and Indians, who employ native labor.

Most of the area of Nyasaland Protectorate is a rugged plateau with a few lofty peaks. The Livingstone Mountains, which reach a height of nearly 10,000 feet, rise close to the border of Lake Nyasa. The narrow strip of

alluvial soil that lies in some places between the lake and the mountains and along the rivers is cultivated by the native Bantus. Europeans cannot endure these hot and humid lowlands but must seek the higher and often less fertile places. The natives produce not only more bananas, corn, and rice for their own use but more cotton and tobacco for export than do the European farmers. The development of Nyasaland was long hampered by lack of transportation facilities. A railway bridge, opened in 1935 across the lower Zambezi River in Mozambique, has given it direct rail communication with the Mozambique seaport of Beira.

EASTER. The greatest festival of the Christian church commemorates the Resurrection of Jesus Christ. It is a movable feast, that is, it is not always held on the same date. The church council of Nicaea (A.D. 325) decided that Easter should be celebrated on the first Sunday after the first full moon on or after the vernal equinox (March 21). Easter can come as early as March 22 or as late as April 25.

In many churches, Easter is preceded by a season of prayer and fasting, called Lent. This is observed in memory of the 40 days' fast of Christ in the desert. In the Western church the Lenten season is from Ash Wednesday until the noon of Holy Saturday—the day before Easter. These six weeks and four days include 40 fasting days, since Sundays are not fast days. In the Eastern churches, Lent extends over eight weeks, and they do not observe Saturdays as fast days.

Ash Wednesday gets its name from the practise, in the Roman Catholic church, of putting ashes on the foreheads of the faithful, to remind them that "man is but dust" and that he must do penance. The second Sunday before Easter is *Passion Sunday*, and the week following is now usually called *Passion Week*, though Passion Week originally meant the week before Easter. *Palm Sunday*, one week before Easter, commemorates the triumphant entry of Christ into Jerusalem. Churches are decorated with palms, and in Roman Catholic churches palms are blessed and distributed. *Holy Week* begins on this day. *Holy Thursday*, or *Maundy Thursday*, commemorates the Last Supper of Christ with his disciples. *Good Friday* commemorates the Crucifixion.

The Easter service is the most elaborate of the church year. The message, "The Lord is risen," is expressed in ceremonies, prayer, and music. Besides the elaborate church services, sunrise services are held outdoors in many places. Some of these have won national fame because of the beauty of their surroundings, such as those at Pikes Peak in Colorado, in the Grand Canyon of Arizona, and in the Hollywood Bowl.

Many and various are the Easter customs that have been brought to the United States from the Old World. The white lily, the symbol of the Resurrection, is the special Easter flower. Colored eggs and rabbits have come from pagan antiquity as symbols of new life. The Easter Monday egg rolling on the lawn of the White House—a custom of European origin—is said to have been introduced in Washington by Dolly Madison.

In many Catholic countries, Lent is preceded by a *carnival* season. "Carnival" means "flesh, farewell," and this is a time for merrymaking. Elaborate pageants often close this season on *Shrove Tuesday*, the day before the beginning of Lent. This day is also called *Mardi Gras* ("fat Tuesday"). The Mardi Gras celebrations of New Orleans and other Southern cities are famous.

The name Easter comes from the ancient Anglo-Saxon goddess of spring, *Eostre* or *Ostara*, in whose honor an annual spring festival was held. Some of our Easter customs have come from this and other pre-Christian spring festivals. Others come from the Passover feast of the Jews, observed in memory of their deliverance from Egypt (*see* Passover). The word "paschal," meaning "pertaining to Easter," like the French word for Easter, *Pâques*, comes through the Latin from the Hebrew name of the Passover.

Easter and Ash Wednesday dates for the years 1943–1952 are as follows:

	Ash Wed.	Easter		Ash Wed.	Easter
1943	Mar. 10	Apr. 25	1948	Feb. 11	Mar. 28
1944	Feb. 23	Apr. 9	1949	Mar. 2	Apr. 17
1945	Feb. 14	Apr. 1	1950	Feb. 22	Apr. 9
1946	Mar. 6	Apr. 21	1951	Feb. 7	Mar. 25
1947	Feb. 19	Apr. 6	1952	Feb. 27	Apr. 13

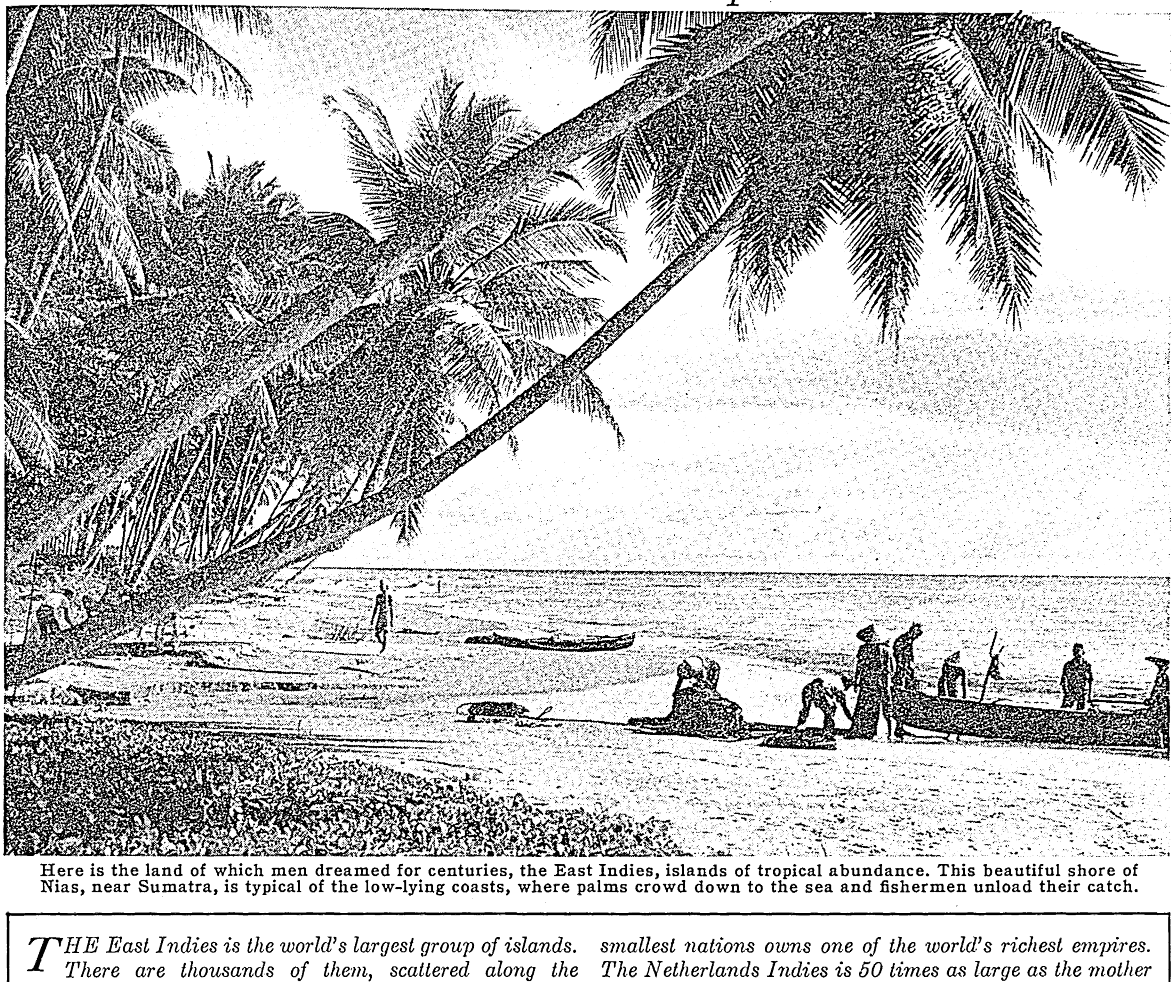
EASTER ISLAND. Far out in the South Pacific, about 2,500 miles west of Chile, is one of the loneliest and most interesting islands in the world. Its nearest neighbor is Pitcairn Island, 1,400 miles away. The native population of only about 400 is the remnant of a numerous people who were once skilled workers in stone and wood and had a form of writing different from any other one known.

Scattered over this volcanic island of 70 square miles are many gigantic statues, each carved out of a single block of soft stone. Some are 30 to 40 feet high. Many have been transported several miles from the quarry in which they were carved, and set up on great stone foundations. Why were these huge figures carved and how were they moved? No one knows. The present inhabitants have no traditions that explain this, and the old picture writing has not been deciphered. (For pictures, *see* Pacific Ocean.)

The people who carved the immense statues, built the great stone houses, and cut records on wooden tablets evidently had a comparatively advanced civilization. The decline of this civilization has been explained as the result of wars, diseases brought by whalers early in the 19th century, and finally the transportation of most of the inhabitants to work the Peruvian guano fields about 1860. A small number of survivors were later returned to the island and converted to Christianity, but the old skills and traditions were gone.

The island, called by natives Rapa Nui, was named Easter Island by a Dutch navigator, Jacob Roggeveen, who discovered it on Easter Day, 1722. Chile annexed it in 1888 and made it a national monument in 1935. A Chilean company leases part of it for a sheep ranch.

The "SPICE ISLANDS"—*Their People and* TREASURES



Here is the land of which men dreamed for centuries, the East Indies, islands of tropical abundance. This beautiful shore of Nias, near Sumatra, is typical of the low-lying coasts, where palms crowd down to the sea and fishermen unload their catch.

THE East Indies is the world's largest group of islands. There are thousands of them, scattered along the Equator between southeast Asia and Australia. They range in size from Borneo and New Guinea, which are each larger than Texas, down to mud flats of an acre or two.

All told they cover more than a million square miles—one-third as much as the United States. They have some 90 million people—mostly brown and black—with only two or three hundred thousand whites.

Two-thirds of this vast region and four-fifths of the people are ruled by the Netherlands. Thus one of Europe's smallest nations owns one of the world's richest empires. The Netherlands Indies is 50 times as large as the mother country and has nearly ten times as many people. These tropical islands normally supply nine-tenths of the world's quinine, one-third of its rubber, and a large proportion of its tin, tea, and spices.

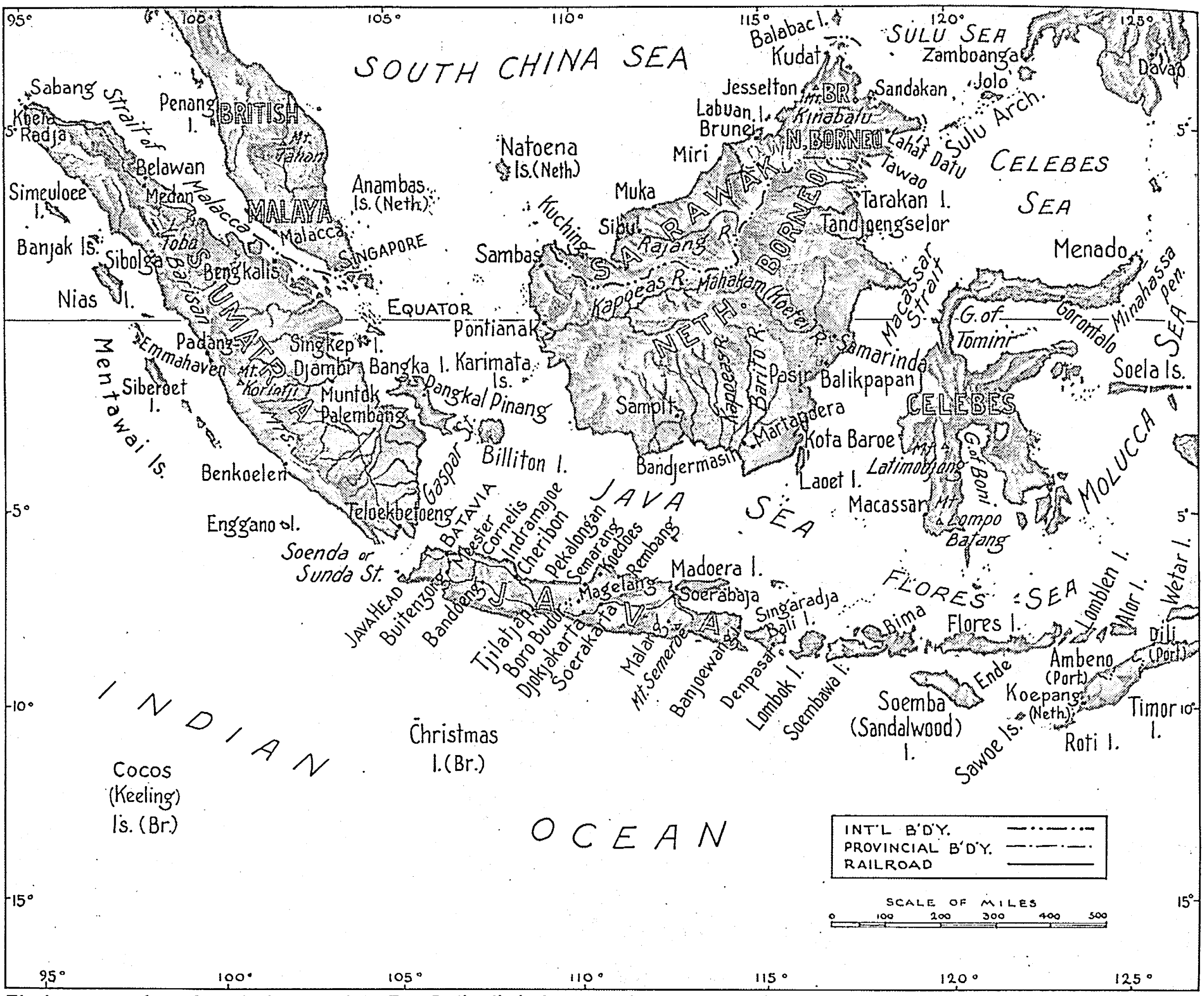
Only one group of islands in the East Indies is self-governing. This is the Philippines. The other colonial powers are the British Empire, which has parts of Borneo and New Guinea with adjacent islands, and Portugal, which has half of the small island of Timor.

EAST INDIES. For centuries medieval Europe was fascinated by tales about the Spice Islands. It was from this distant unknown region that spices came. Spices were enormously important in the diet of the Middle Ages and sold for high prices. After the Crusades, the spice trade became one of the most profitable branches of commerce, and Europeans longed to trade directly with the islands. (*See* Spices.)

In 1488 joy bells rang in Portugal when Bartholomew Diaz returned from finding the beginning of a sea route around Africa to these fabled lands. Four years later Columbus rejoiced to think—though he was wrong—that he had found a westward route to them. Thirty years after Columbus' first voyage Magellan did find this route, and one of his ships sailed around the world for the first time in history (*see* Magellan).

Thus the Spice Islands were one of the magnets which drew Europe on to its "Golden Age of Discovery." For the next four centuries, the seafaring nations of Europe often fought for these rich islands, which came to be known as the East Indies. By the 19th century, the Netherlands held most of them, and a few million Dutch people in Europe kept millions of natives pouring out tropical products and minerals.

But some nations looked enviously at so little a country holding so great a prize. Japan in particular was jealous. It lacked resources at home, and these islands could supply its need for petroleum,



The large map shows how the islands of the East Indies lie in festoons, like necklaces of beads strung between large ornaments. One large festoon runs from Australia through New Guinea to Celebes; another runs from Malaya through Sumatra through Java to Timor.

rice, cotton, rubber, and many metals. So in 1941 Japan added one more war to the long series by attacking and seizing them.

Extent of the Islands and How They Were Made

These thousands of rich and trouble-breeding islands are called either the East Indies or the Malay Archipelago. Another name, used by many Dutch writers, is Indonesia. They stretch along both sides of the Equator for a total span of about 3,800 statute miles —more than the distance from New York to Cadiz, Spain. From Manila in the Philippines to Batavia in Java is almost as far as from New York to Yucatan.

Some of them are huge. New Guinea and Borneo are both larger than Texas. Sumatra is larger than California, Luzon and Mindanao in the Philippines are both larger than Indiana, and Java is about the size of Louisiana. Hundreds of smaller islands lie in festoons between these big ones.

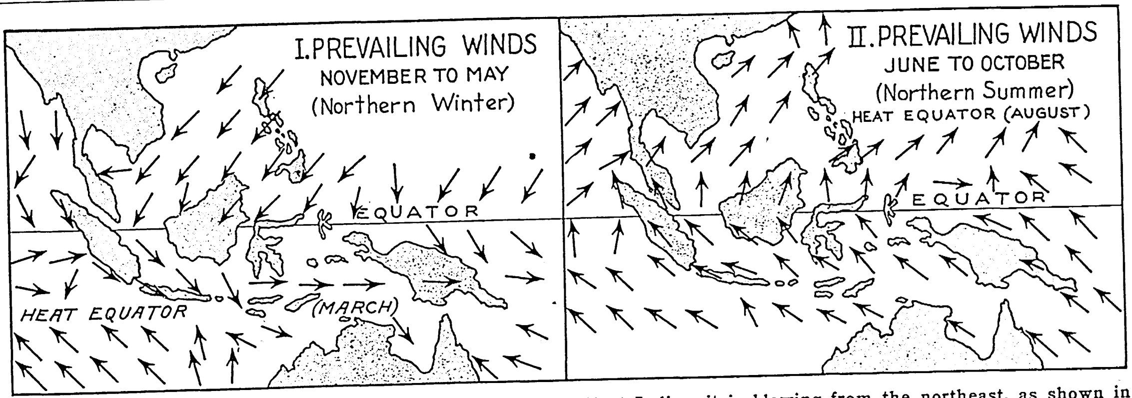
Some geologists believe that an almost empty sea once separated Asia and Australia. But in a recent age southeast Asia moved or swelled toward the Pacific Ocean, with the basin of the South China Sea leading the movement. This threw the ocean floor up in ridges around the edges of the moving mass, and the tops of these ridges rose above the sea as islands.

Along these ridges the earth's crust weakened and let molten rock well up from below. This made a line of volcanoes through Sumatra and Java to Timor, then north to the Philippines; another line rose in New Guinea. Many of these volcanoes are still active, and earthquakes occur frequently.

Hot Climate and Luxuriant Plant Life

Since the islands lie in the ocean along the Equator, the general climate is hot and wet, with frequent thundershowers. The rainfall, between 100 and 150 inches a year in most places, favors growth of dense forests. At sea level, the mean temperature ranges between 80° and 90° F., and it varies only a few degrees throughout the year. But most of the islands are mountainous, and the climate becomes subtropical at about a third of a mile above sea level. The higher peaks rise above 10,000 feet and have a cool climate. Some in New Guinea have perpetual snow. Monsoon winds and the mountains together cause wet and dry

RICH ISLANDS IN TROPICAL SEAS



Since the East Indies are located near the Equator, in a vast expanse of sea, the climate is basically of the marine equatorial or "doldrum" type, with light winds and frequent thundershowers. These are most intense in the zone of greatest heat (the "heat equator"), which shifts north and south with the seasons. But this general climate is modified by seasonal monsoon winds from Asia, and by the existence of mountain ranges.

From November until May the winter monsoon blows outward from Siberia over the Pacific Ocean. During this movement it curves toward the west, as is explained in the article on Winds. By the time it approaches the Equator and the East Indies, it is blowing from the northeast, as shown in Map I. It also has picked up moisture from the China Sea, and it drops this as rain on the north and northeast slopes of the mountain ranges. The sheltered sides have a dry season.

From June until October, when the interior of Asia is hot, the summer monsoon blows from the south or southeast toward Siberia, as shown in Map II. Then the south and southeast sides of the mountains get rain, from Sumatra to central Java. East of here, however, the wind has come from Australia, and it has little moisture. Hence from central Java through New Guinea, the season is dry.

PART OF THE MOUNTAINOUS BACKBONE OF THE EAST INDIES

Sumatra's highlands (above), seen across Lake Toba (3,000 feet), are typical of the mountainous interiors of the East Indies. Erosion of volcanic cones like this produces rich soil. Here it is worked by Bataks, an industrious hill people. Their houses (left) are thickly thatched against the heavy rains.

seasons, as the sketches on page 142*a* show. The dry season, from June to October, is particularly marked on all southern slopes from central Java eastward.

As the traveler approaches a typical island, it looks like a tropical fairyland. From a low swampy or sandy shoreline the land rises sharply to a purplish peak or range of mountains in the background. The forest starts almost at the water's edge. Teak, ironwood, ebony, and other valuable timber trees are mingled with palms—hundreds of kinds of them. The most useful are the coco, the sago, the nipa, and the vinelike rattan (*see* Palm). Bamboo grows in dense thickets. Huge ferns and brilliant flowers are everywhere.

These equatorial forests extend from Sumatra across Borneo and western Java. Farther east, where pronounced dry seasons occur, the forest is replaced by savanna or grassy jungle, dotted with thorn bushes, bamboo, and stunted eucalyptus trees. But here too forests grow in the swampy deltas of many rivers. On the higher, cooler mountain ranges grow azalea, rhododendron, oak, laurel, maple, and some pine.

Animals and Wallace's Line

The animal life of the islands shows a striking regional division along Wallace's Line. This name comes from the naturalist Alfred Russel Wallace, who announced his discovery of this division in 1869.

Wallace's theory begins with the fact that the sea is not 300 feet deep over the whole stretch between the Malay Peninsula, Borneo, Sumatra, and the island of Bali, just east of Java (*see* map). This suggests that in the past all this western division was one land. The animal life bears this theory out. Asiatic animals such as tigers and rhinoceroses, as well as many monkeys, apes, and birds, are found throughout this division. But the animals of all the islands east of Borneo and Bali are like those of Australia. This fits the geologists' belief that these eastern islands once were linked with Australia and got their animal life from that continent. Wallace ultimately concluded that the line separating these two kinds of life runs between Borneo and Bali on the west and Celebes and Timor on the east. (*See also* Australia.)

The Natives and How They Live

The people too differ east and west of this line. West of the line the islands are inhabited mainly by Malays, a short, brown-skinned people akin to the southern Chinese (*see* Malay Peninsula). These people are skilled boatmen, farmers, and metal workers. The mountain Malays, called Dyaks in Sumatra and Borneo, and Igorots in the Philippines, are less advanced than the lowland Malays.

East of the line, the natives are mostly Negroes and Negritos, of the Papuan and Melanesian groups. They live largely by gathering wild food and by fishing. These people are supposed once to have occupied all the islands before the Malays came from Asia and

seized the best regions. On the western islands, Negritos now live only in the remote mountain regions. (*See* Pacific Ocean.)

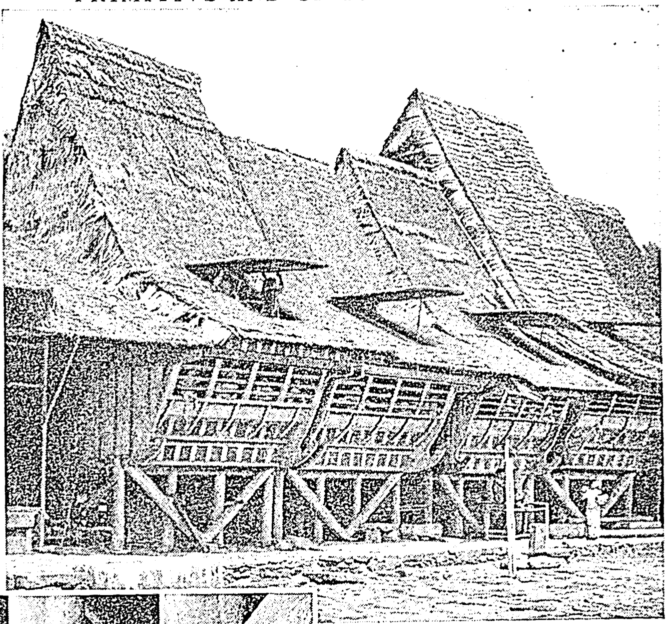
All these people have much the same ways of life. Their villages are usually in a clearing on a river. The houses are set on piles, and occasionally in trees, to be above the wet earth. They have floors of split bamboo and roofs thatched with nipa palm leaves. Some walls are thatched; others are merely mats hung between uprights.

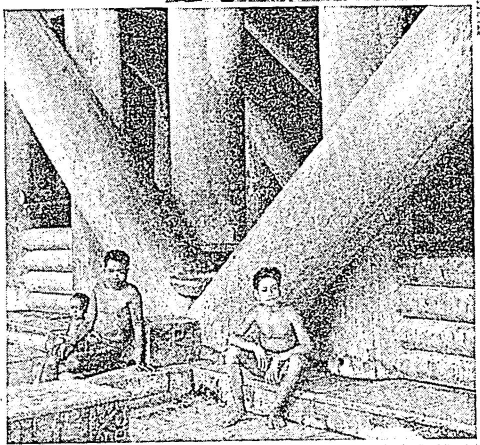
For food, the people fish in the river or the sea and gather fruit in the forest. The more advanced Malays also grow rice, often in terraces built along mountainsides. Common vegetable crops are millet, corn, cucumbers, and peppers. The favorite food animals are chickens and pigs. There are cattle for work and food, but the natives do not use milk.

For clothing, Negritos wear a grass or palm leaf skirt, or perhaps just a loin cloth. Malays wear a shirt, a turban, and a sarong—a square of colored cloth draped to form a skirt.

Except for the Christians in the Philippines, most of the Malays are Mohammedans. The hill Malays, or Dyaks, and the Negritos believe in spirits and ghosts, and practise magic. They used to preserve the heads of their enemies, because they believed that this enslaved the spirit of the dead man. They also buried an enemy's head with a dead chief or under a new house. Head hunting is forbidden now, but the Dutch government lets some tribes keep old heads. In Borneo the government even keeps a few to lend to villages when needed for magic ceremonies.

PRIMITIVE AND CIVILIZED BUILDERS





Most primitive tribes in the Indies are content with thatched huts. But the people of Nias show unusual architectural skill and build "apartment houses" (top) supported by massive logs (center). Open walls and "skylights" give light and air.

The Javanese, most advanced of the East Indians, use light-weight materials. They weave split bamboo for the walls and palm-leaf thatch for roofs. But they follow the cottage style of white men. Throughout the Indies, houses are raised to escape the wash of heavy rains.

Wherever white influence is strong, the native ways of life have been greatly changed. In Java, almost half of the land has been cleared, and the countryside has been as nearly Europeanized as a tropical land could be (*see* Java). Elsewhere, such changes rarely extend far from the seaports.

The Netherlands Indies, a Vast Empire

The Netherlands owns the lion's share of this immense territory of more than a million square miles, with about 90 million people. The only exceptions are the Philippines, the British parts of Borneo and New Guinea with the adjacent islands, and the Portuguese half of the little island of Timor. (*See* Borneo; New Guinea; Philippine Islands.)

The Netherlands Indies are one of the world's richest co-

lonial empires. It is more than fifty times as large as the mother country, with ten times the population. The natives number about 70 millions, against a European population of only some 240,000. The latter group includes the Eurasians—people of mixed white and Asiatic blood. The Dutch accept the Eurasians as white, and even intermarry with them. There are more than a million Chinese and a sprinkling of Hindus, Japanese, and Arabs.

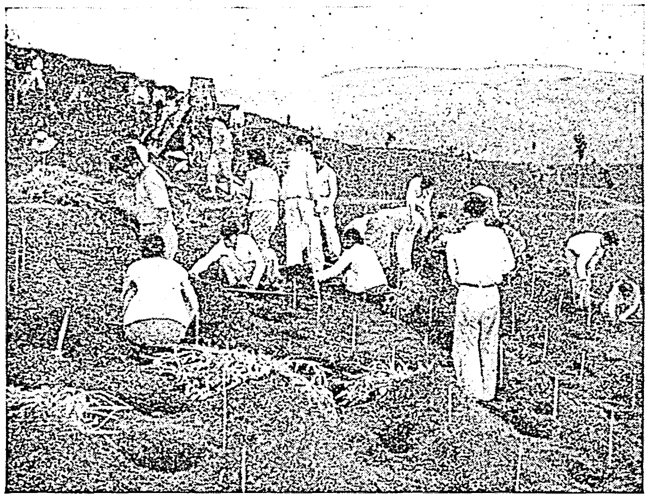
Their Gifts to the World

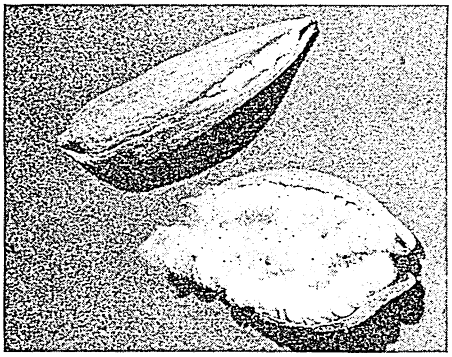
Originally a source only of luxuries, such as rare woods and spices, the East Indies came to supply raw materials for many of the world's daily needs. The Netherlands Indies alone usually produce one-third or more of the world's rubber; about a fifth of its tin, agave and sisal fiber, and palm-oil products; three-fourths of the kapok; considerable quantities of tea, coffee, and sugar; and almost all of the world's supply of pepper and quinine.

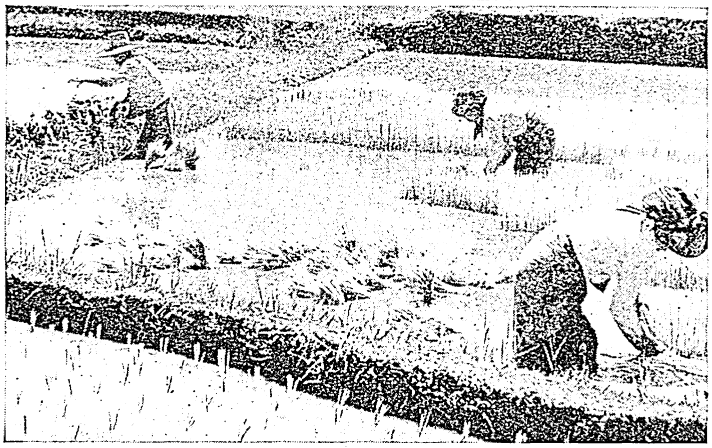
Another useful gift is petroleum. The Netherlands Indies usually rank fifth in production. The output is only about 3 per cent of the world total, but scarcity of oil fields in East Asia makes Indies petroleum immensely important throughout this part of the world.

The Dutch islands normally supply about 2 per cent of the world's export trade. The Netherlands, the United States, the British Empire, and Japan take most of the exports. The United States normally gets from the Indies about a fifth of its rubber, half of its palm oil, a third of its sisal, and a tenth of its tin. The Indies take their imports mostly from the same countries. These include rice, iron and steel, machinery, cotton goods, chemicals, and a wide variety of other manufactured goods.

AGRICULTURE AT DIFFERENT ALTITUDES







Different altitude levels favor a variety of crops. Irrigated fields in the warm lowlands grow rice. Here it is being transplanted from thick seed beds. As the land rises, you find *ceiba* trees. Their kapok fiber (center) is an important cash crop, especially in Java and Celebes. The warm moist highlands (1,500 to 3,500 feet) of Java and Sumatra grow tea for export (top). These Javanese are setting out plants in the rich volcanic soil.

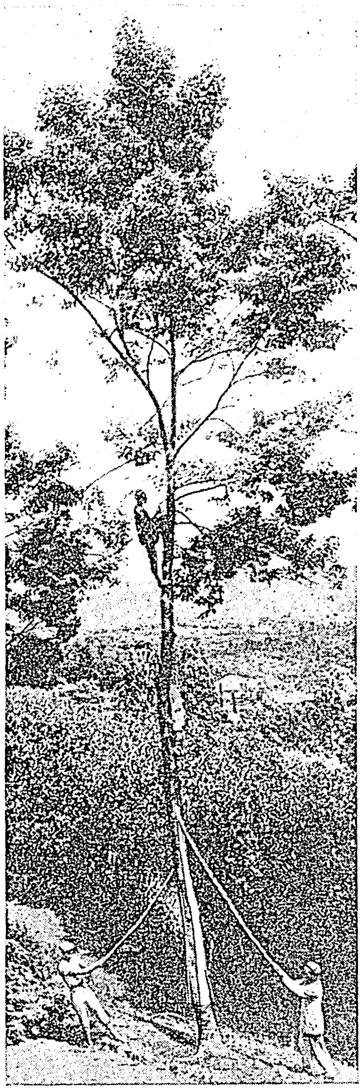
Farms and Crops

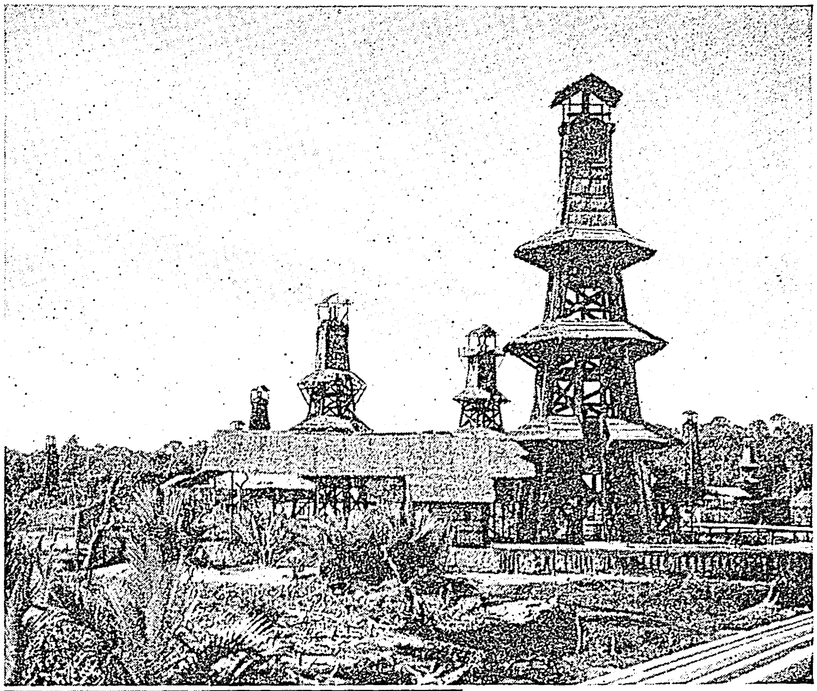
Most of the exports, as well as the means of living for about 70 per cent of the inhabitants of the Dutch Indies, come from agriculture. Until the 20th century, the natives grew crops only for themselves, and export crops were produced on "estates." These are large tracts which European and Chinese owners lease from the government or from native rulers.

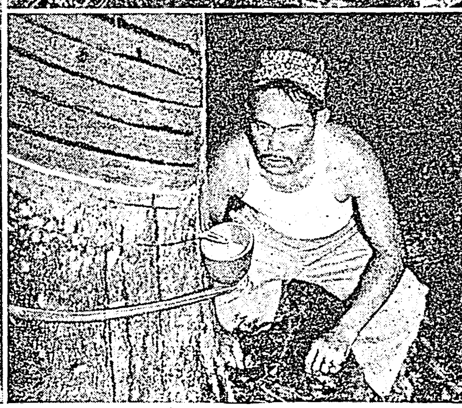
This system produced large profits, and paid taxes enough to meet almost all cost of government. It also made it easy to introduce scientific methods and profitable new crops. Tea growing started early in the 19th century, and now the Dutch islands normally export more tea than China or Japan. Cinchona trees, brought from South America, now produce most of the world's quinine. Rubber is an important product of Sumatra, Borneo, and Java. The palm-oil tree, brought from equatorial Africa, has made the Indies the leading source of palm oil, used in soaps and margarine.

But the estate system employed only about a tenth of the farm workers. It kept the native standard of living low, because independent farmers could not produce for export in competition with the estates. These evils came to a head early in the 20th century, when the population of Java outran food production. The government then provided credit, irrigation, and other aid for small operators, and promoted immigration to

THREE IMPORTANT PRODUCTS USED THROUGHOUT THE WORLD







Bark stripped from cinchona trees on the highlands of Java and Sumatra (extreme left) supplies nearly all the world's quinine. Oil fields like this on Tarakan island (above) make the Indies a leading producer of petroleum. The islands are also a major source of rubber. At the left, one of the many Chinese workers on the rubber estates is gathering latex.

the Outer Islands, as the Dutch call all their possessions except Java and Madoera. There the people obtained land and soon were growing more than half of the exported crops.

Wealth from Forests, Minerals, and Industry

Forests still cover about one-fifth of Java and more than two-thirds of the land elsewhere. Exported forest products include rattan, resins, camphor, and tanning barks. The most valuable minerals are tin and petroleum. The tin is on the islands of Bangka, Billiton, and Singkep, near Sumatra (*see* Tin). Petroleum production began in eastern Java and Madoera, but a larger output has come from Sumatra, the Molucca Islands, and Borneo, with its adjoining islet Tarakan. Sumatra and Borneo yield small amounts of coal, gold, and silver. Some bauxite, manganese ore, asphalt, and phosphates are also mined.

When business depression cut the sale of export crops after 1930, the government promoted industries for processing raw materials, such as petroleum, tin, sugar, and palm oil. It encouraged the "native industries" such as woodworking and making batik, leather, pottery, and hats. Natives were also trained for factory and shipyard work.

The government also spent large sums on vocational training and village schools. Its public health program reduced malaria and bubonic plague, and it put villages as well as cities under strict sanitary rule in all the well-settled regions.

Sea Lanes, Air Lines, and Railroads

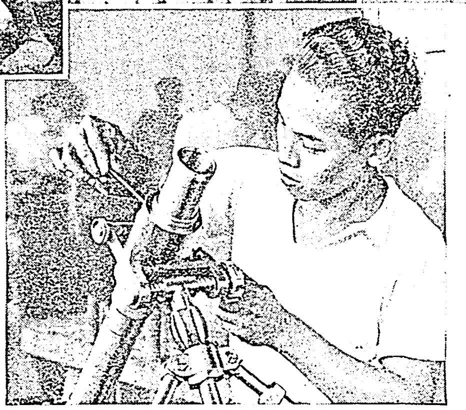
Today, just as centuries ago, the islands rely largely upon water transportation. An extensive system of air lines also serves the islands and provides connections with Australia, Asia, and Europe. The air link with the home land flies 11,000 miles.

Little need has been felt for railroads. Java has about 4,000 miles; the few other lines feed seaports in Sumatra. Most of the 43,000 miles of improved roads are in Java and Sumatra.

The Long and Troubled History of the Indies

The Malays, who are the most numerous of the inhabitants, spread over the islands in several waves. Hindus from India also set up states in Java and

OLD ARTISTRY AND MODERN SKILLS



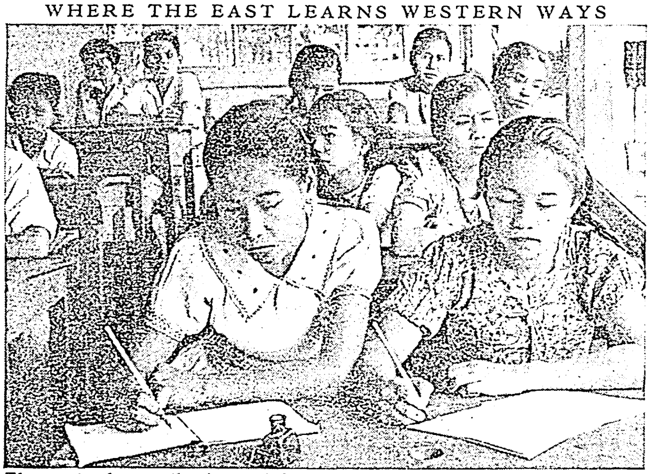
The Malays have a rich heritage of Hindu arts and crafts. A Balinese sculptor (top, left) works on an ornate temple god. The poised, graceful girl reflects the training of Balinese dancers. A turbaned wood carver (right) instructs his son. All wear beautiful batik sarongs. The young Javanese (left) turns his manual skill to machine work.

Sumatra, perhaps as early as the first century after Christ. These states were destroyed after the 12th century by a fresh wave of Malay invaders, who had been converted to Mohammedanism. Only the ruined temples and sculptures of Java and Sumatra remain as memorials of Hindu rule.

Before the Christian era the spices and other rare goods of the Indies were finding their way to Europe. The Portuguese visited the Moluccas in 1511, and soon after established a capital at Ternate, in the heart of the spice trade. They made shipments to Lisbon, and let the Dutch, then under the rule of Spain, distribute the merchandise throughout Europe.

Spain gained complete control of this trade when Philip II assumed the Portuguese crown in 1580. Next year, when the Dutch revolted, Philip barred them from the Indies. But after the defeat of the Spanish Armada in 1588, the Dutch, knowing that Spanish power in the Indies was weak, set out to seize the region. Their first expedition was in 1595–97, and the venture was organized in 1602 as the United East Indies Company. In 1611, they established a capital in Java at Jakatra (renamed Batavia in 1619). Within half a century they ousted the Portuguese from all but a last foothold on Timor. Spain, however, retained the Philippines (*see* Philippine Islands). Occasional wars were fought between the Dutch and the English until 1811, when the English seized all the East Indies as a countermeasure to Napoleon's annexation of Holland to France. After the fall of Napoleon, the Dutch agreed to British dominance in Malaya and the British gave back the islands in 1816.

WHERE THE EAST LEARNS WESTERN WAYS

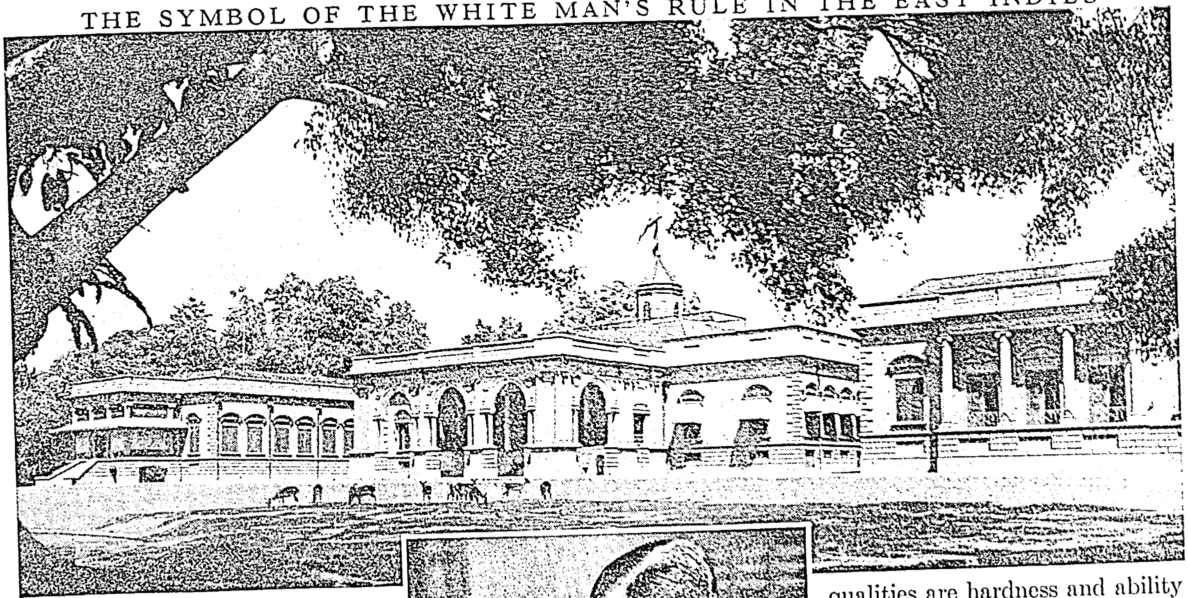


These sturdy, neatly dressed Sumatran students are typical of Dutch schools in the Indies. The chief educational aims are to improve the health standards of the natives and to train them for work in modern industries. Elementary schools are usually taught in Malay. Higher schools use Dutch.

Thereafter the Dutch rule was generally peaceful except for wars with Javanese sultans (1825–30) and with various Sumatran tribes. These tribes were not finally subdued until early in the 20th century.

During the struggles with the English, the East Indies Company proved unable to cope with its problems, and the Netherlands govern-

THE SYMBOL OF THE WHITE MAN'S RULE IN THE EAST INDIES



The residency of the Dutch governor general is at Buitenzorg, about 35 miles south of Batavia. Officials like Hubertus J. van Mook, lieutenant governor general, made the government a model of liberal colonial administration.

ment revoked its charter in 1798. The new administration continued a policy of exploitation until exposure of abuses roused public opinion at home, and led to the beginnings of an enlightened and progressive colonial policy in 1854. This policy retained the estates system but liberalized the treatment of natives.

In recent times the chief problem was the attitude of Japan. The two nations had been friendly, until after the first World War. Then influential Japanese began to talk of a "Greater East Asia" and to advocate "southward expansion." When Japan invaded Manchuria in 1931, the Dutch began strengthening the defenses of the East Indies. Their fears were justified when Japan started war in December 1941. Despite a gallant defense against overwhelming odds, Japan conquered the Indies when it succeeded in overwhelming Java during March 1942. (For the history of the conflict, *see* World War, Second. *See also* articles on the principal islands, and **East Indies**, in the FACT-INDEX at the end of this volume.

Dutch Government in the Indies

Before the changes brought by war in 1942, the Netherlands Indies were ruled by a governor general, appointed by the Netherlands crown. The partly elective parliament (*Volksraad*), established in 1916 and opened in 1918, gave a measure of self-government. Many local matters were entrusted to *dessas*, or native village communities, acting through councils of elders. The Native States were under princes or sultans advised by Dutch officials. A small part of Java and more than half the area of the Outer Islands were under this type of rule.

EBONY. The saying "black as ebony" gives one reason why this wood is valuable. Cabinetmakers value it for its jet-black color. Its other highly prized qualities are hardness and ability to take a high polish. Hence ebony is used for piano keys, inlaying, cabinetwork, and knife handles.

Ebony wood is obtained from about 15 species of tropical and semitropical trees, which grow in the East Indies, India, and Africa. Ceylon and southern India are the leading producers of the true ebony, of jet-black color. Only the heartwood of the true ebony is used, because the sapwood is white. Some species yield a brown wood, rather than a black. One species, the persimmon, grows in the United States from Connecticut to eastern Texas (*see* Persimmon).

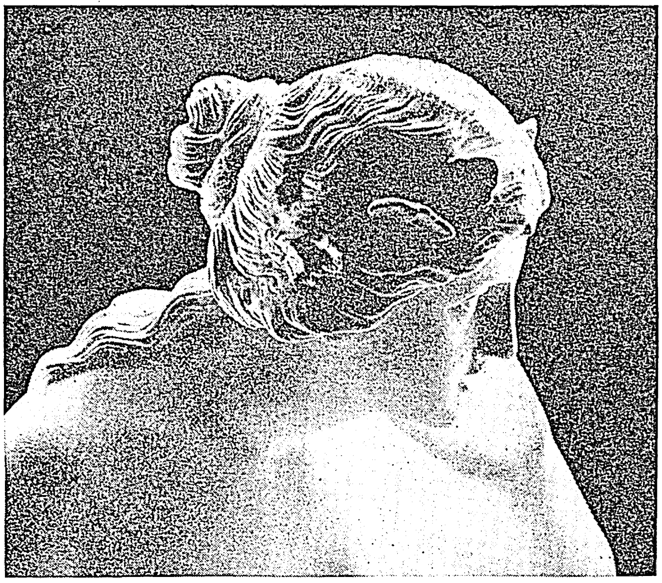
Most commercially important ebony trees belong to the genus *Diospyros* of the ebony family (*Ebenaceae*). The most important are the *Diospyros ebenum* of southern India and Ceylon, and the *Diospyros melanoxylon* of the East Indies, which yields Macassar or Coromandel ebony.

ECHO. A beautiful nymph named Echo fell in love with Narcissus, an old Greek myth tells us. But he did not care for her, and she pined away until only her whispering voice remained, with strength enough to answer the last word of any call she heard.

This was the poetical Greek explanation of an echo. The scientific explanation is that sound waves are reflected from flat surfaces. An irregular surface breaks up the waves, just as a rocky shore breaks water waves into spray. But a smooth surface, such as the side of a cliff, reflects sound waves, and we hear the reflection as an echo.

Because the reflected waves have lost strength, they cannot be heard until the original sound has ceased. If you are about a hundred feet from the reflecting surface, you hear only the final syllable of

AND ECHO ANSWERS "YOU"



The Greeks had a myth that echoes were the voice of a nymph who had pined away from hopeless love until only her voice remained. She was supposed to haunt the woods and rocks and repeat the last syllable of any cry she heard. Above is the head of a beautiful statue by the sculptor Herzig, representing Echo listening for a call.

what you call. If you take your stand farther back, more and more syllables can be heard.

Sir Isaac Newton used the echo in a corridor at Trinity College, Cambridge, to measure the speed at which sound travels. Standing at one end of the corridor he started a group of sound waves by stamping his foot. These waves were thrown back by the wall at the far end of the corridor. He timed the interval between stamping his foot and hearing the echo. He knew the distance to the wall and back; and from these factors he calculated a speed for sound which was within a few feet a second of the speed which modern science has determined (*see* Sound).

ECLIPSE. The primitive Northmen thought the sun and moon were pursued by two enormous wolves, who now and then very nearly succeeded in devouring our chief sources of light. Even till recent days the Chinese believed a solar eclipse was caused by a great dragon attempting to swallow the sun. On such occasions they would go out into the streets and set up a terrific din to frighten the monster away.

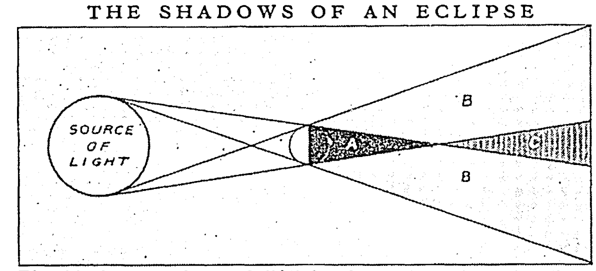
The facts are not so romantic, though it would be near the truth to say the sun and moon and earth are playing hide and seek with one another. A solar eclipse occurs when the moon gets between the sun and earth, obscuring the sun from our view. A lunar eclipse, on the other hand, is caused by the shadow which the earth casts on the moon when the earth is between the moon and the sun.

Imagine a straight line drawn through the sun and earth and extending beyond the earth on the other side. If the moon in its monthly trip around our planet always passed directly through this line, first on one side of the earth and then on the other, we should see two eclipses every month—one of the sun and one of the moon. But the moon moves in an orbit which is tilted somewhat away from the orbit made by the earth in its annual journey around the sun, and for that reason eclipses are comparatively rare. There may be as many as four of the sun and two of the moon in a year, or there may be no eclipses of the moon and only two of the sun. In many cases, of course, these eclipses are only partial, and from a single spot on the earth it is not likely that a total solar eclipse will be observed more than once in 300 years. An "annular" eclipse is one in which a considerable rim of the sun is still visible around the edge of the moon; it occurs when the moon is farthest from the earth.

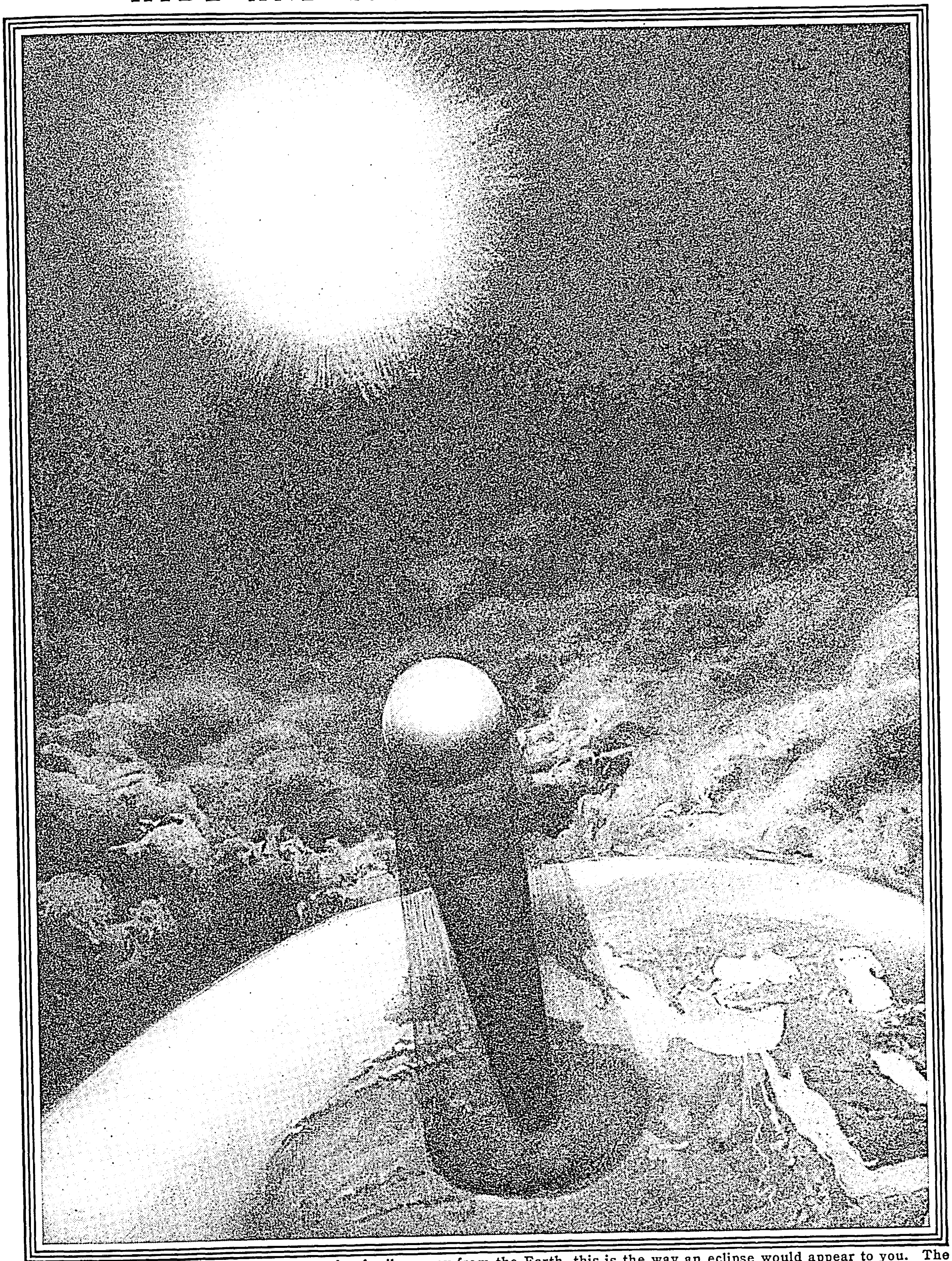
It is little wonder that primitive people were frightened by a solar eclipse. For a period of seven minutes or less the earth is plunged in darkness, the stars flash out, flowers close up, birds go to rest, and cattle in the field become restless and terrified. Around the edges of the moon can be seen numerous rose-colored prominences, while shooting still higher—200,000 miles or more from the surface of the sun—are streamers of pearly light which constitute the *corona*. This can only be observed at the time of an eclipse. A solar eclipse is always the occasion of numerous expeditions of scientific men who travel long distances to find a favorable place for observation.

The scribes of ancient days often noted down the occurrence of eclipses. Sometimes the sudden hiding of sun or moon altered the course of history by arousing the superstitious fears of the people. By means of mathematical computation, astronomers can now determine exactly when these events must have taken place. One celebrated example is mentioned by Herodotus, when the Medes and Lydians, after fighting for five years, laid down their arms and made peace because of the occurrence of a solar eclipse just as they were about to go into battle. This date has been fixed as May 28, 585 B.C. Other planets beside the earth eclipse their satellites, and certain stars are sometimes darkened by companion bodies, but these phenomena are usually called "occultations."

THE SHADOWS OF AN ECLIPSE



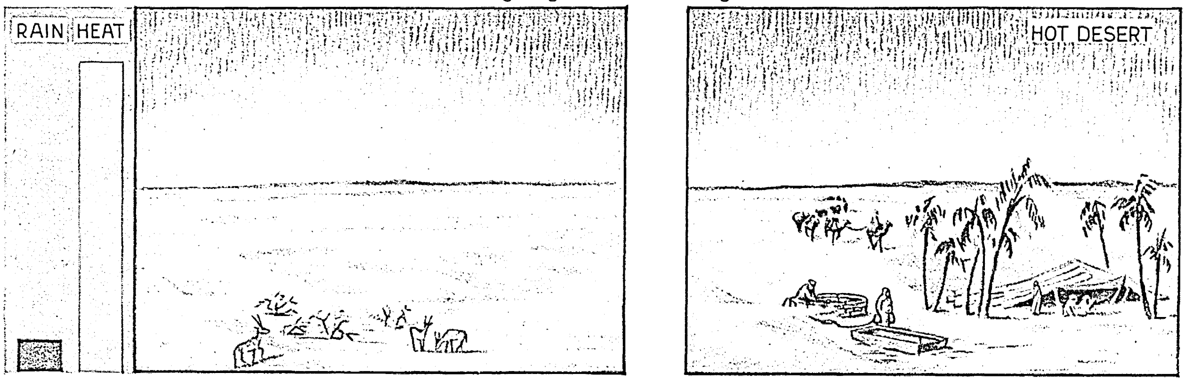
The black space lettered "A" is the region of total eclipse called the "umbra." The space marked "B" is the "penumbra," or region of partial eclipse, from which a crescent-shaped portion of the sun is seen. In the space "C" the sun is seen as a ring, with a dark spot made by the moon in the center.



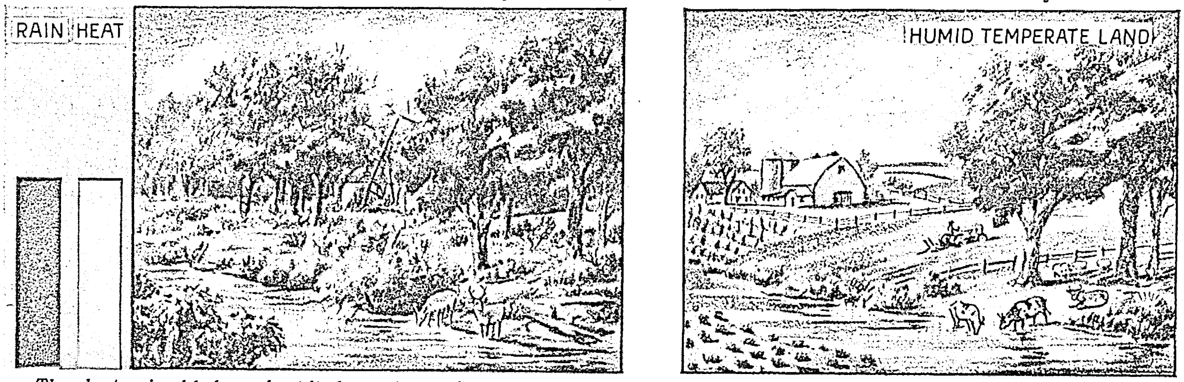
If you were floating in space some thousands of miles away from the Earth, this is the way an eclipse would appear to you. The Moon, you see, has come in line with the Sun, and casts down its conical shadow. Complete darkness comes in only one comparatively small circle—in this case in the middle of the Sahara Desert in northern Africa. But partial darkness extends over a much larger area, where only part of the sun can be seen.

HOW HEAT AND MOISTURE INFLUENCE LIFE

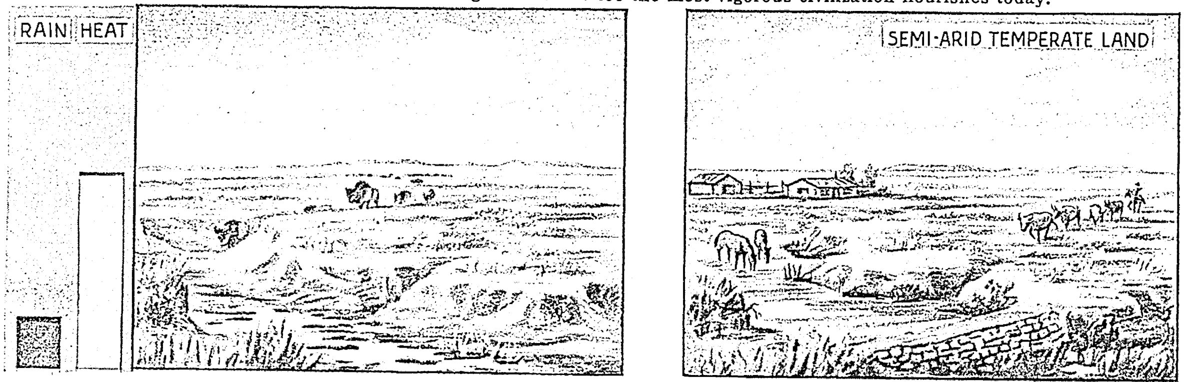
Great heat with heavy rains produces the kind of forest shown here. At the right we see a primitive native settlement typical of this environment. Here men must fight against excessive vegetation and a too abundant insect life.



Here the red and blue bars at the left show great heat with very little rain—the conditions that create a desert. Only around the rare water holes can life of any kind exist, and the oasis is the center of all human activity.



The plant-animal balance is at its best where rain and heat are moderate. It is in this type of environment that farming prospers and most of the world's food is grown. Here too the most vigorous civilization flourishes today.



Scanty rainfall in a temperate zone usually means treeless plains with meager water courses, like the old buffalo ranges of the West. These now support cattle and sheep but, without irrigation, farming is difficult or impossible.

ECOLOGY—*The Study of Community* RELATIONSHIPS *Among Plants, Animals, and Men*

THOUGH Ecology is one of the youngest of the sciences, it is one of the most important for the future of mankind. It studies the relations of living things to the world in which they live, and tells us, among other things, how we can most effectively use and conserve our resources. Many of the most pressing problems of today are ecological. How can we make the best use of our land? How can we save our soil, our forests, and our wild life? How can we reduce the great losses caused by harmful insects? These are samples of the practical questions the ecologist asks and tries to answer. Few of us will become ecologists, but we can all better understand the world we live in and better adjust ourselves to it if we know something about Ecology.

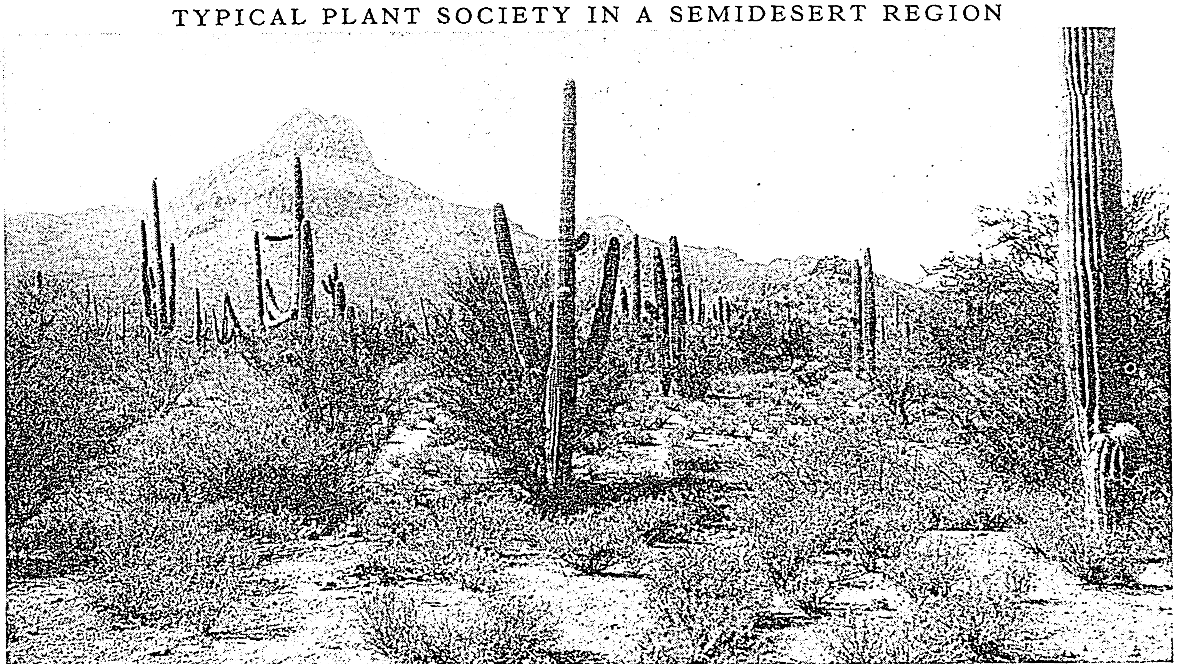
ECOLOGY (*ē-kŏl'ŏ-gĭ*). Few living things stand alone. Where we find one kind of plant or animal we almost always see other kinds near by. In deserts and in cold regions the number of different kinds existing together in one place may be small. In more favorable regions thousands of species may dwell on a single acre. But in every instance we can be sure that the plants and animals found together are not associated with one another by mere chance.

We know first of all that each kind of life is suited to the physical conditions of the spot where it lives—the kind of soil, the amount of moisture and light, and the varying temperatures and seasons. Second, we know that each of them is living there because, for the time being at least, it is able to hold its own in its relations with its neighbors. What we may not realize is that the continued existence of such a group or *life community* is a matter of delicate balance and of complicated adjustments among its members. Some very slight change, the removal of a single species from the group or the addition of a new species, may have astonishing results.

If you told a farmer, for example, that he could increase the red clover in his pasture by adding a number of domestic cats to his household, he might not take your suggestion seriously. Yet the relation between cats and red clover is clearly explained in Darwin's 'Origin of Species'. The cats will kill field mice. This will save the lives of many bumblebees, whose nests and grubs would otherwise be destroyed by the mice. This in turn will mean that there will be more bumblebees at work fertilizing the clover blossoms—a task for which they alone are fitted. And the more thoroughly the blossoms are fertilized, the more seed will be produced, and the richer will be the next clover crop.

Ecology deals with plant and animal communities. It treats of the relations of living things to the world in which they live, that is to say, their environment. It investigates chains of cause and effect, like the cat-mouse-bee-clover example given above. It suggests ways in which we can read nature's secrets more intelligently and apply our knowledge to make the forces of nature serve us more effectively. The name

TYPICAL PLANT SOCIETY IN A SEMIDESERT REGION



One glance at this picture made near Tucson, Ariz., tells the trained ecologist a great deal more about the life of that region than his eye can see. The cactus plants and mesquite bushes show him that water is scarce. He knows that the insects, birds, and four-footed creatures found there will all be of the kind that require little moisture.

of this branch of science is newer than the subject it covers. For men have always been concerned with the problem of life and environment.

I. THE NATURE AND PROBLEMS OF ECOLOGY

Even before the days of science, the wild hunter who knew that deer must come to the salt lick for salt was a practical ecologist. So was the fisherman who knew that a flock of gulls hovering over the water marked the position of a school of fish. So was the native doctor who sought for his herbs in the proper soil at the right time of year. Before the days of calendars men used ecological facts to guide their yearly round of work. They planted corn when oak leaves were the size of a squirrel's ear. And the noise of geese flying south was a warning to prepare for winter. The scientific study of such things was for a long time—until perhaps 1850—known as Natural History and the man who studied nature out-of-doors was called a naturalist. Meanwhile Natural History was being broken down into special fields, such as geology, geography, zoölogy, and botany, and the students moved indoors. They did their work in the laboratory with the aid of the microscope and other apparatus.

Some Questions Ecology Tries to Answer

But while scientists were busy in the workshop, other men were working out-of-doors with living things, in field, forest, stream, and ocean. Forester, rancher, farmer, gamekeeper, fisherman—all worked daily with living things. Often they found themselves asking help from science. But many of their questions could not be answered in the laboratory.

The forester, for example, wants to know why trees do not thrive on the prairie, the desert, the high mountain tops. He also wants to know why certain trees live together. Why is hickory usually found with oak, and beech with maple?

The rancher wants to know how to manage his pastures so his cattle will thrive. And he needs to know how such animals as coyotes, rabbits, hawks, and gophers affect his business. Almost every part of the farmer's work is a problem in ecology. The gamekeeper sooner or later finds out that his job means much more than keeping out one set of hunters so that another set can shoot the game. For game must have the right kind of food to eat in all seasons of the year, places to live and raise its young, and the kind of cover it is accustomed to.

> **INFLUENCE OF ALTITUDE ON VEGETATION AND POPULATION**
>
> The upper half of the pictograph on the opposite page shows the relation of altitude to vegetation in three different latitudes—in Mexico, in the French Alps, and in Iceland.
>
> In the diagram representing Mexico palms stand for tropical vegetation. Above them are shown hardwood trees, grain fields, and the semidesert vegetation that exists at those altitudes when the climate is too dry for trees or grain. Still higher are shown the evergreen trees, forming the timber line. Beyond them comes an area of scrub vegetation, and at the very top, above 15,000 feet, an entirely barren region commonly covered with eternal snows.
>
> In the diagram of the French Alps the lower levels show hardwood trees, grain fields, cultivated pasture lands, and vineyards, with evergreens, scrub, and barren lands above. But notice how much less elevated are the vegetation belts than in Mexico. The evergreens, which in Mexico live at 12,000 feet, flourish at 5,000 feet in the Alps.
>
> In the cold climate of Iceland the evergreens exist at sea level and the upper limit of scrub vegetation is 3,000 feet.
>
> The lower half of the pictograph shows how the population is distributed in the three regions. Notice that in Mexico the densest population is found around 7,000 feet above sea level. If you have already discovered why, then you are a good amateur ecologist. Where is the center of the food-growing area of Mexico? Where is it in the French Alps? As for Iceland, it has no rich food-producing area. It supports about the same number of people to the square mile as do the tropical forests along the coast of Mexico.

The fisherman finds that most fish will not do well in muddy rivers, so he has to know why rivers become muddy and filthy. He becomes interested in the management of the landscape when he discovers that the troublesome mud comes from land where trees have been cut, or from cattle ranches that have been badly handled, or from farms that are running down.

If the fisherman lives near the ocean, he wants to know what makes the fish abundant in one place and scarce in another. He must know the feeding and breeding habits of the fish from which he makes his living, and of the smaller animals and plants upon which the larger fish must feed.

Wide Scope of This Young Science

All these are ecological problems. To answer them the ecologist must know something of a good many different sciences. He must understand biology, which is the science of living things, including botany (plants) and zoölogy (animals). He must understand the science of weather and climate; of rocks, earth, and soil; of water and its behavior.

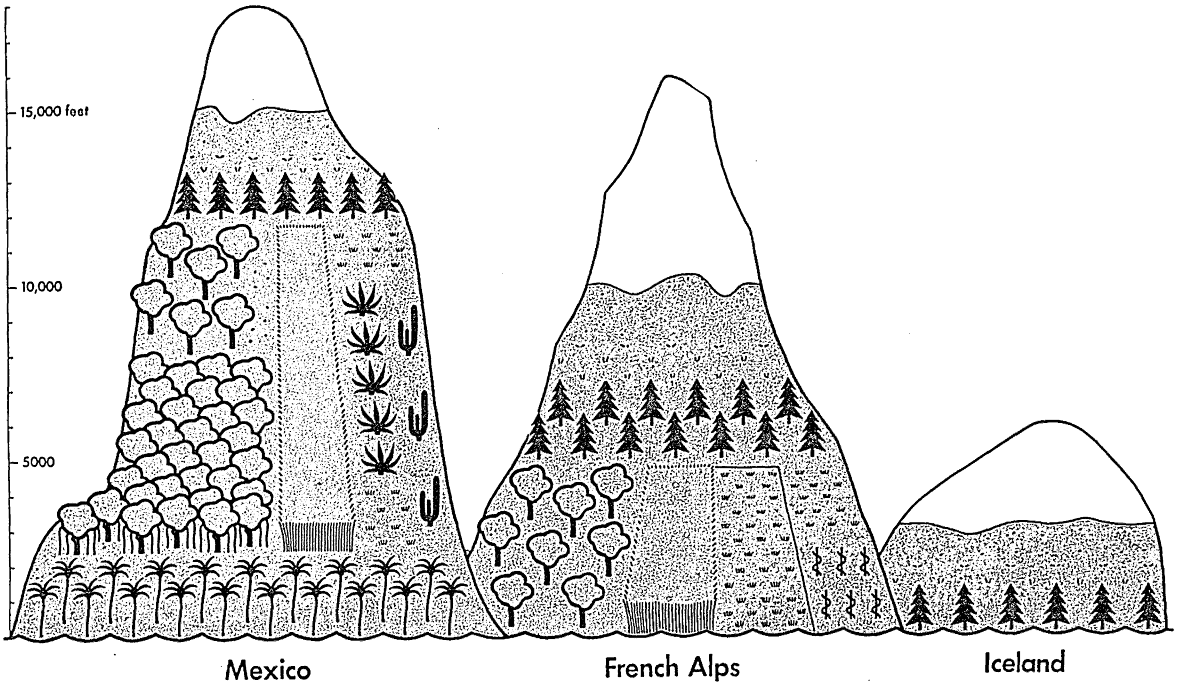
The word ecology was coined in 1886. It comes from the Greek word *oikos*, meaning "household." This is the same word from which economics takes its name; but economics deals with human business, while ecology deals with nature's housekeeping.

Ecology must look into the past and the future. The condition of a forest or a field today cannot be understood without knowing its earlier history. In traveling across the Rocky Mountains we often see great stretches of light-green aspen trees, while near-by mountains may be covered with dark-green fir and spruce trees. This shows that a forest fire destroyed the evergreens where the aspens stand today. The aspens are fire trees, coming in to heal ground scarred by fire. They are worthless for lumber. If we watch through the years, we find that young aspens do not come up in the shade of the old. Often, before the aspen trees are 40 years old, spruce and fir seeds begin to germinate in their shade, and in the course of time the evergreens regain their lost territory. This illustrates what is meant by saying that ecology is a way of looking backward and forward in time.

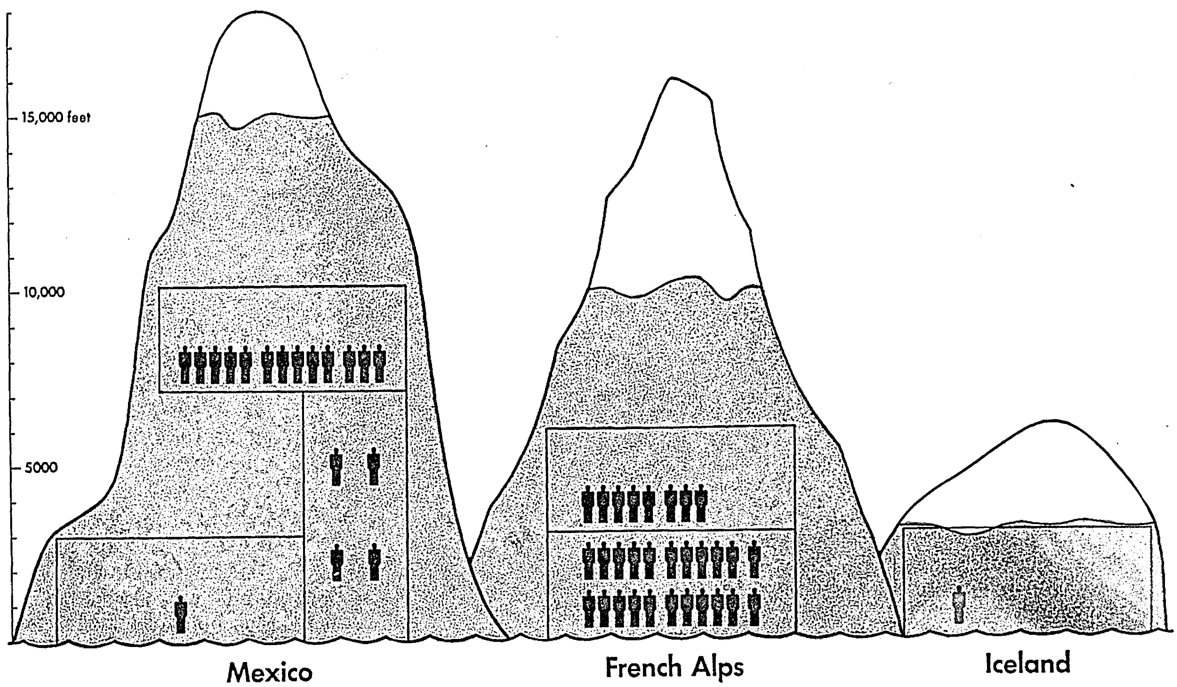
II. THE ECOLOGIST AT WORK

Suppose we look next at a few practical problems which the ecologist has helped to solve. Let us take first a very simple one. In 1913 southern Ohio had

Vegetation and Altitude



Population and Altitude



Each symbol represents 10 inhabitants per square mile

Prepared for Compton's Pictured Encyclopedia
© International Foundation for Visual Education

These two pictographs show the effects of altitude on vegetation and on population in three different latitudes. On the opposite page is an explanation of the symbols used and a discussion of some of the points illustrated here.

a destructive flood, sometimes called the Dayton flood. The people were determined that this would not happen again. They built great dams of earth across the valleys north of Dayton to hold back the flood waters. But the sloping sides of these dams were mostly gravel with a little clay. They washed away very easily. It was necessary to get some kind of cover on these steep slopes as quickly as possible.

An ecologist was asked for his advice. He knew what plants would grow best in such places and recommended that alfalfa and clover seed be scattered on the hillsides, followed by brome grass and Japanese honeysuckle. Today the slopes of the dams are covered with a fine turf which holds them in place, while many of the hills on neighboring farms have been washed and cut by running water.

Somewhat like this is the valuable work done in the "dust bowl" region of Texas, where the sandy soil of that dry country had blown into great dunes or heaps as a result of plowing it for wheat. To level off these dunes with machinery would be very expensive. So the ecologist at work there found plants which would grow near these shifting dunes. Those in front of the dunes caught and held the soil as it blew into them, while those behind the dunes kept the rear from blowing deeper. In a remarkably short time the wind had leveled off the high tops of the dunes and the vegetation had anchored the soil in place.

Measures to Conserve Our Wild Life

A good example of ecological work with animals is to be found in the studies of ducks and other migratory wild fowl. When these birds grew scarce, state and federal agencies sought ways to protect them and increase their numbers.

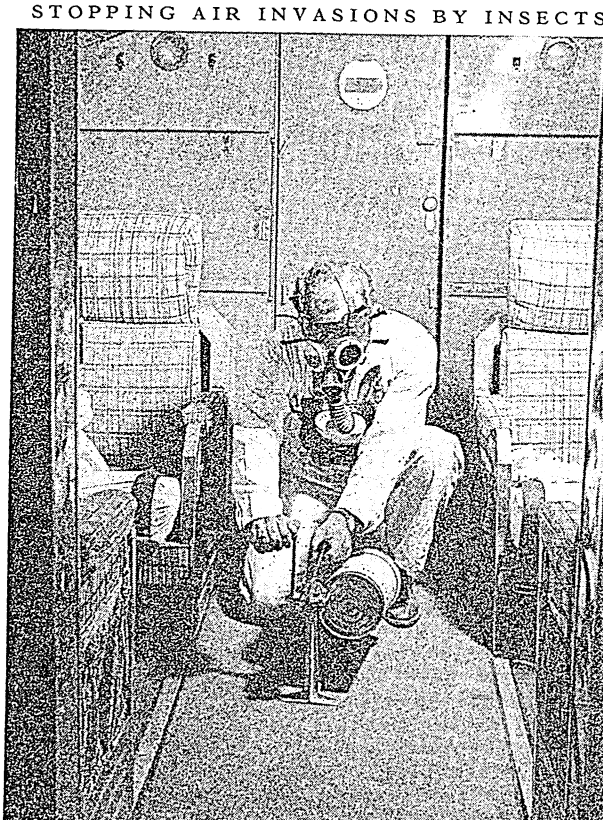
They first recommended laws to forbid shooting in the spring as the birds were flying north to nest. Each female killed in the spring meant one less brood returning in the fall. Further studies showed that many of the breeding places were being destroyed by careless draining of the land for other uses. Often such places were not fitted for permanent agriculture and so the money expended in draining them was worse than wasted. By capturing birds and putting numbered aluminum bands on their legs, their breeding places and movements were traced and it was shown that the problem was international. As a result of this discovery, it became necessary for the United States government to work in close coöperation with its neighbors in Canada and Mexico.

It became important, too, to know about the food habits of the birds. For it is not enough to protect the birds from hunters or to see that they have places to breed. If proper food for them is not available, they will starve and disappear anyhow. Experts examined the stomach contents of many thousand birds from all places and at all seasons of the year. From their work we learned that this food consists largely of plant materials which are most abundant under favorable natural conditions, and that to provide these materials it is necessary to have areas undisturbed by man and uncontaminated by the poisonous wastes of his factories and cities. (*See also* Birds.)

A Mistake That Had to Be Corrected

The ecologist sometimes finds that measures which seem practical to the average man are really mistakes. A few years ago both cougars (mountain lions) and deer were abundant in Grand Canyon National Park and in the adjacent Kaibab National Forest. Because cougars preyed on deer, hunters were allowed to shoot them in the Kaibab until they almost disappeared. With their chief natural enemy gone, the deer increased so rapidly that they consumed more forage than the Kaibab could produce. They stripped it bare of every leaf and twig they could reach and destroyed large areas of forage in the Grand Canyon Park as well. The deer grew feeble, and many of them were born defective. Finally it was found necessary to throw the forest open to hunting and thus reduce the size of the deer herd to the feeding capacity of the range. The cougar, on the other hand, was protected, in the hope that the few survivors would multiply and that cougars would then resume their ancient function of keeping the deer herd down and of killing those deer not vigorous enough to be

STOPPING AIR INVASIONS BY INSECTS



Because airplanes entering the United States from foreign ports may be carrying new insect pests as stowaways, the planes are thoroughly inspected and fumigated with cyanide gas as soon as they arrive. The fumigator wears a gas mask for protection.

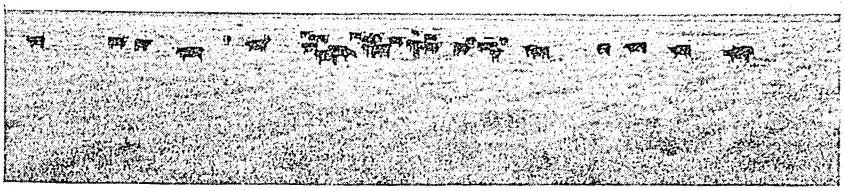
good breeding stock. This is only one of many instances to prove that interference in the balance of nature cannot safely be undertaken without careful study.

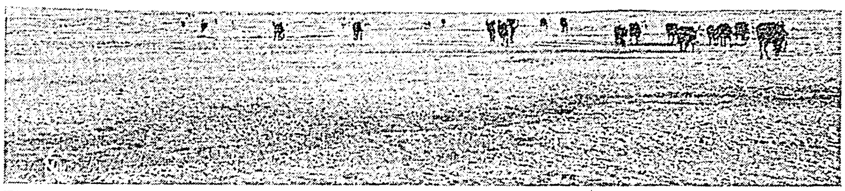
Control of Pests

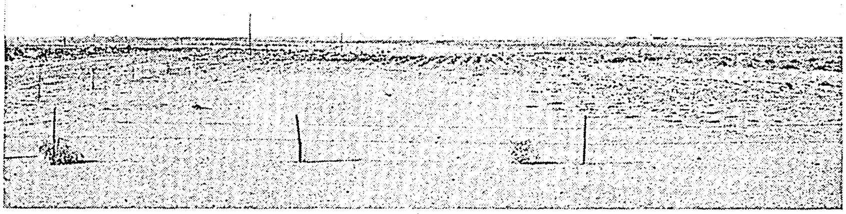
With the aid of ecology, new and better methods of dealing with insect and other pests are being developed. America suffers especially from such pests because many of them have been introduced from the Old World, where they had been held in check by their natural enemies, and where the plants or animals they infested had somehow become adjusted to getting along in spite of them. Introduced without these checks, and with unlimited food available because of the replacement of native plants and animals by domestic ones, pests have often spread like wildfire.

Our first efforts to control these pests were a good deal like calling out the fire department. We tried poison sprays and other violent means. These methods are expensive and not always successful. Gradually we are trying to replace these emergency methods by measures which enable us to get along in spite of the pests, just as we prevent fires with fireproof buildings and other precautions. We have found in some cases that severe damage from certain pests—for example, the Mexican beetle and the European corn borer—is confined to crops grown on particular types of soil or under certain conditions of moisture. By changing our type of land use we can foil the insect. We can control some insects by bringing in their parasites or other enemies from the lands where they originated. This has been done with scale insects (*see* Scale Insects).

LAND RUINED BY IGNORANCE, RESTORED BY SCIENCE


American cattlemen found in the West millions of acres of prairie like this where the buffalo had ranged. The land, covered with hardy natural grass, was ideal for stock grazing. But due to our ignorance much of this vast region was soon reduced to an apparently worthless desert.


First the range was overstocked. The grass was cropped down by cattle and sheep until it looked like this. Without a sufficiently thick shield of living grass, the underlying sod dried up.


The government mistakenly encouraged thousands of settlers to farm this land. Here was the result. When the plow had broken the sod, wind and rain carried away the good top soil.


To reclaim this desert was a job for practical ecologists. Furrows were plowed across the slopes (contour listing) to catch and hold surface water. Oats, sorghum, and sudan grass with a scattering of hardy trees and shrubs, were planted to hold the soil. This checked the erosion.


Less than a year after the previous photograph was taken, the wind-blown desert had been reclaimed and looked like this. Later the land was seeded to grass again and the cattle returned.

Also we are slowly beginning to see that by destroying the breeding places of our native birds and other animals we have lost valuable allies in our endless war with insects. Recently when the sportsmen of Ohio came forward with a request to allow restricted shooting of quail, which had been protected for years in that state, the farmers blocked the proposal. They know that the cash value of a single quail on the farm is equal to that of at least a dozen chickens because of the insects it kills (*see* Quail).

The conservation of our native birds, like the restoration of our forests and rivers, means the opening up of an entirely new kind of work for the future. This work we may call *designing the landscape for civilization.* As yet we have scarcely made a beginning.

Finding How to Avoid Old Mistakes

As further examples of practical work which the ecologist has done, we may cite his studies of competition among forest trees; the building of soil through the activities of plants and animals; the restoration of streams and lakes through better control of the land which drains into them; and the behavior of the root systems of plants. In the past few years, great progress has been made in this last-named work. Already the study of this underground realm of life has given us a much better understanding of prairie pastures and fields of growing crops. The effects of competition, drought, mowing, severe grazing, and burning are much better understood than they were before we knew how roots grow and behave. Means of avoiding old mistakes are at hand for those who will use them.

III. IMPORTANT PRINCIPLES OF ECOLOGY

Because ecology is so new and deals with such complicated relationships, it is difficult to set down a list of laws or principles and say: "These are the laws of ecological science." Many such principles are known, but a statement of them and an arrangement of them which would seem reasonable to one worker might not seem so to another.

Each Living Thing Has Particular Needs

We might state one principle as follows: *The pattern of life reflects the pattern of the physical environment.* If one travels west from Indiana and looks at the woods as he goes, one will see that the beech tree is not found much farther west than Chicago. The sugar maple extends to Iowa, and then disappears. The red oak and the linden are found in forests on the west bank of the Missouri, and the hickory a little farther west. Beyond that, only a handful of eastern trees remain, including the bur oak, and there they are found only along streams. Now, a study of the weather records will show that from Indiana to Nebraska the climate rapidly becomes drier. Of the trees named, the beech is most sensitive to dryness and sunlight, and the bur oak least so. Thus there is a reason for the order in which the trees drop out from east to west. As one moves on west, moreover, new plants appear which are suited to drier conditions. In the same way, if one starts in at Alabama and moves up to Michigan, one will rapidly leave the live oak, the yellow pine, the sweet gum, and the persimmon—trees which require long warm summers and mild winters.

In short, every kind of plant and animal has a certain set of conditions of moisture, light, temperature, and so on which are necessary to its growth. Where such conditions do not exist, the plant or animal cannot survive without artificial help. Man and his dog seem at first to be exceptions to this rule, for they live all over the earth. But even they cannot live beneath the sea, or in the highest layers of the atmosphere. They too have their limits. The fact that their limits are so wide is due to man's capacity to provide what we might call artificial conditions, through the making of fire, and the building of shelters, and the use of clothing and tools. Without these aids, much of the earth would be closed to man as it is to the polar bear, the camel, and the beech tree.

Communities of Plants and Animals

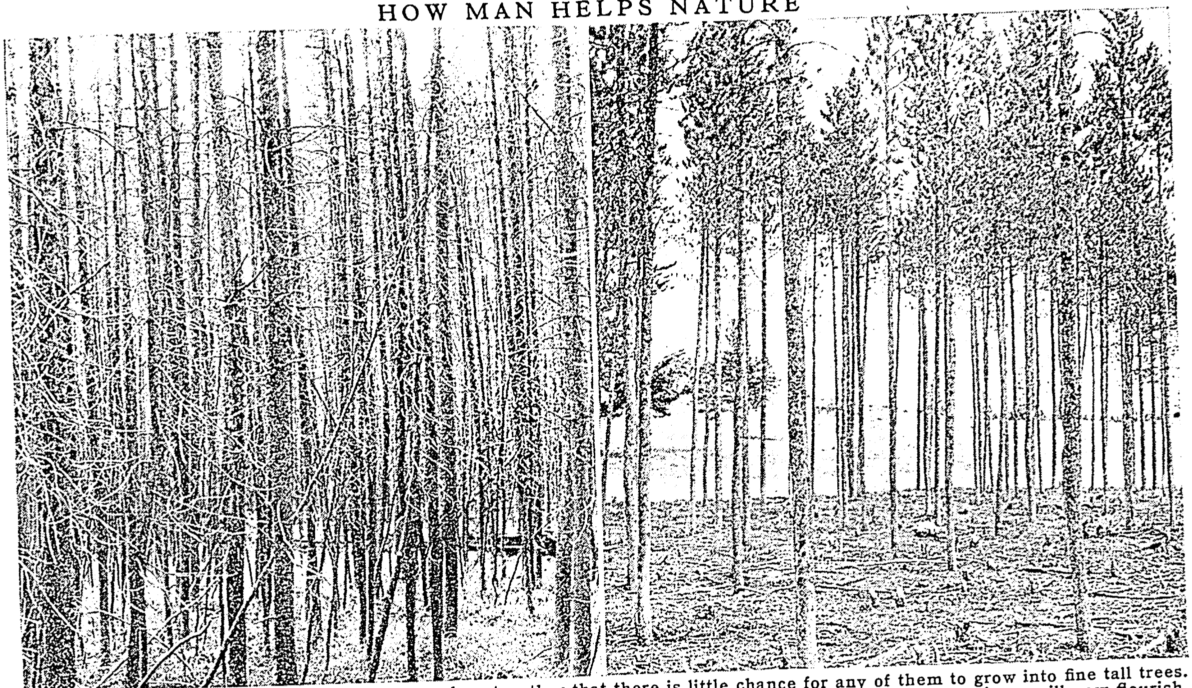
Closely related to this is a second principle, already referred to at the beginning of this article. *Plants and animals tend to group themselves into definite associations known as communities.* The groups of forest trees described above make up one great community called the Eastern Deciduous Forest of North America. The dropping out of one tree after another was really the shading off into another community, called the Grassland Formation or Prairie and High Plains. A third great community is the Desert. Within these large communities are smaller ones with their proper animals and plants. The bison, the coyote, and the jack rabbit were part of the Grassland community, just as the fox squirrel, the wood pigeon, and the black bear were part of the Forest. Furthermore, the Indian tribes who lived in these communities were really part of them because they had to suit their methods of getting food, shelter, and clothing to the conditions around them. They were interdependent with the plants and animals among which they lived.

Succession and How It Is Brought About

A third great principle is this: *Existing communities are the result of a long period of growth and development.* During this time they gradually become changed until, as we say, they fit the conditions under which the community exists. The coming in of aspen after a fire, with its eventual replacement by spruce and fir mentioned earlier in this article, is an example of such a change. Any change in a community, whatever may be its cause, is known as *succession.* Among the causes of succession are changes in the pattern of climate; changes in the pattern of land surface; changes brought about by the community itself; and changes due to the introduction of new forms of life. The last includes the very serious changes produced by man.

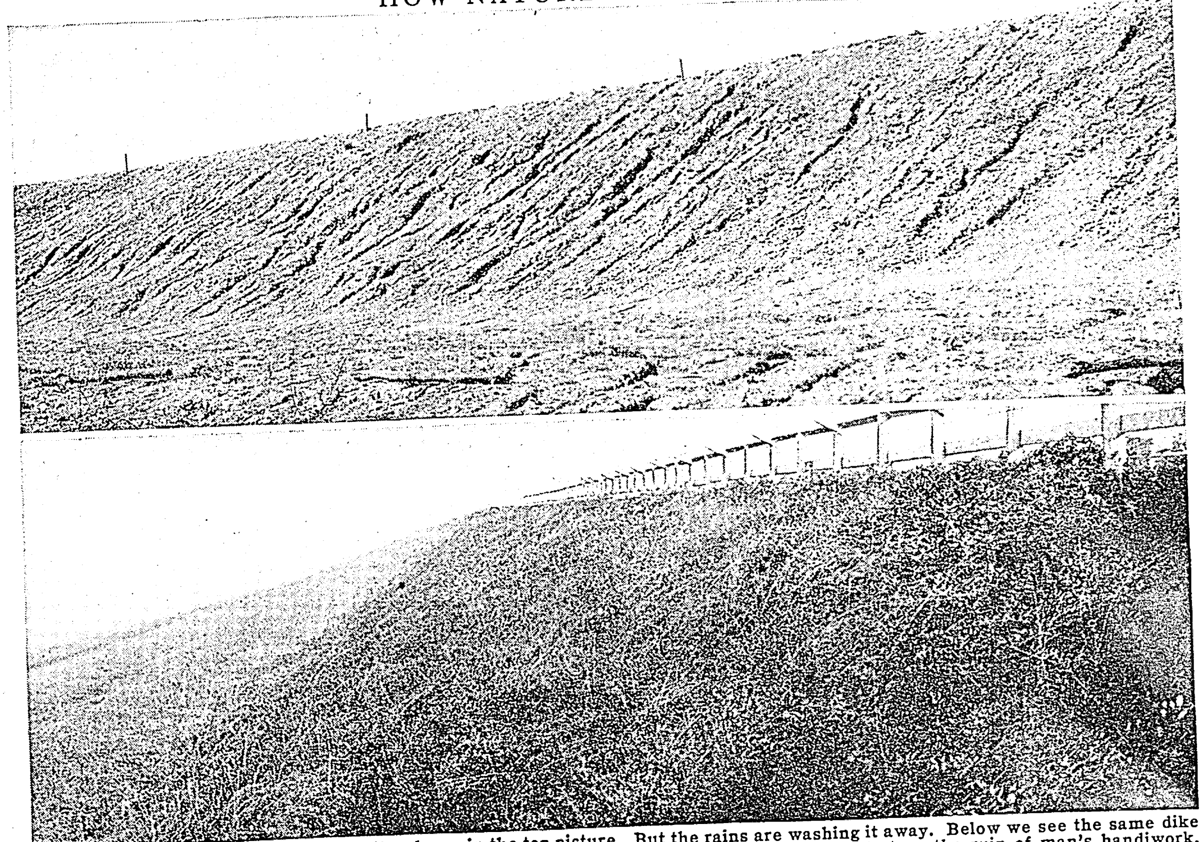
As an example of the effect of climate changes we have the drought of the 1930's in the prairie states. This was only a temporary change. Yet it resulted in the death of many kinds of tall moisture-loving grasses and their replacement by smaller, drought-resistant grasses and weeds. As the climate grows more moist again, the old grasses will doubtless return slowly.

HOW MAN HELPS NATURE



The young pines at the left have sprung up so close together that there is little chance for any of them to grow into fine tall trees. But along comes a forester and cuts down four out of every five, as shown at the right. Virtually all the survivors will now flourish.

HOW NATURE HELPS MAN



To control floods, engineers built the dike shown in the top picture. But the rains are washing it away. Below we see the same dike after tough grasses had been encouraged to grow over its surface. Nature's green blanket stops the ruin of man's handiwork.

Over longer periods more gradual and lasting changes occur. The five great ice sheets of the Glacial Period came down over North America and Europe and the belts of northern life moved south ahead of them. Each time the ice melted back, the plants and animals moved north once more. These changes took thousands of years. (*See* Ice Age.)

Changes in the pattern of land surface take place slowly and on a large scale, when mountains are formed or new land rises up from the sea. More rapid is the action of wind and water in carving the surface of the earth, wearing away hills and filling valleys. As this erosion takes place it changes conditions. In the absence of plant life it proceeds very rapidly, but a cover of vegetation tends to slow it down.

Ravines are at first deep and narrow, cool, moist, and shady. In such places one finds ferns, beech trees, and hemlock. But as the ravine widens and is less protected, a drier type of forest takes possession, for example, oak and hickory.

Changes are also brought about by the community itself. Every living thing helps make the world somewhat different from what it was before. The weeds growing in a vacant lot produce shade and keep the ground from drying out. They bring in insects and birds, and they enrich the soil by decaying when they die. And while the bare ground was the best possible place for the sun-loving weeds to grow, the weedy ground is better for shade-loving shrubs and tree seedlings, or, farther west, for native grasses. So in the course of time the weeds are replaced. One can observe similar changes at the margin of a pond and upon sand dunes, bare rocks, or banks of clay. Wherever such changes occur, the combination of plant and animal life changes until it is of a kind which is able to make the best use of the new conditions. Thereafter the community remains fairly stable. Such a stabilized community is known as a *climax community*. A climax community may be regarded as the most efficient, well-balanced, and permanent form in which living things can make use of available materials and energy.

Again, whenever a new form of life appears in an area from which it has been absent before, it enters into competition with forms already there. Sometimes it is astonishingly successful, as the English sparrow and the starling have been in America since their introduction from Europe. At other times it makes little impression. The Chinese ginkgo tree grows well enough in the United States, but has to be helped along by man; on the other hand, the ill-scented tree of heaven, also from China, springs up and spreads in any vacant valley or fence row.

The principle of succession can be observed in human communities. The things which people do and the way they do them change as the community changes from a frontier outpost to a modern city. Factory replaces blacksmith shop; department store replaces trading post.

Man has also been a potent influence in changing the natural environment, destroying many of the old natural communities and attempting to set up new ones. Many of the world's most serious problems today arise from the fact that man has not yet succeeded in establishing in the territory he occupies the same permanent and balanced relationship which the old communities had.

The Interdependence of Living Things

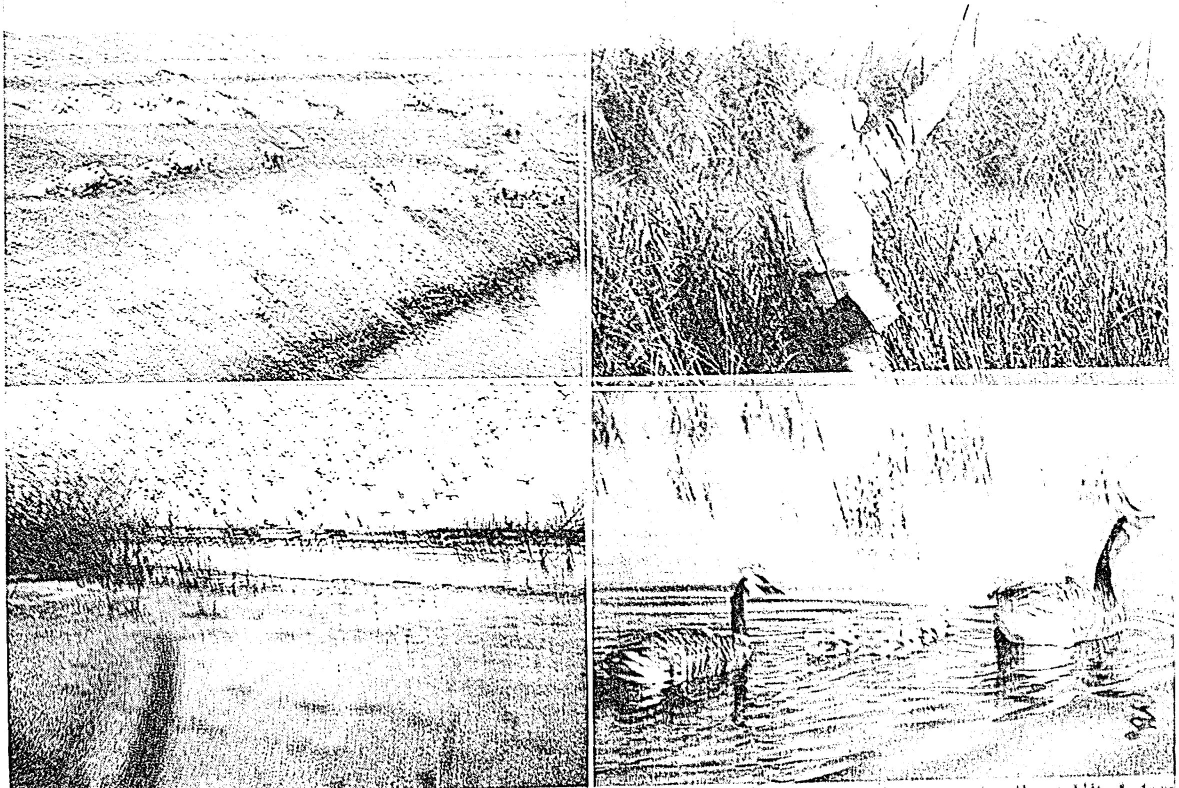
A fourth great principle may be stated as follows: *Other living things are an important part of the environment.* The wheat crop of the farmer can exist only with the aid of myriads of invisible bacteria which work in the soil. The oak tree furnishes the squirrel with shelter and food. In his turn, the squirrel often plants acorns—not intentionally, but because he forgets or fails to find those which he had buried in the soil for future use. The yucca, or Spanish bayonet plant, cannot form seed without the aid of a little moth whose young feed on its seed pods. The yucca can be made to grow in many places where it is not found, but its natural occurrence is limited to the area in which this little moth is found (*see* Yucca). There are all sorts of relationships among and between plants and animals, some beneficial to one or both, some destructive.

In a certain sense, man is one of the most dependent of all living things because he is one of the newest. He is adapted physically to the world as he found it, not as it was back in the Coal Age or the Age of Fishes. It is impossible to imagine civilized man, for example, without the great group of grasses which pasture his domestic animals and furnish him with cereals. These grasses did not appear on earth until long after the Coal Age. Man is dependent, too, upon soil, which is a product of the activity of communities of plants and animals (*see* Soil).

Competition in Nature and Human Society

This brings us to a fifth great principle of ecology which concerns *competition*. Competition is an important kind of relationship in which two living things "seek" the same required condition or material from the environment. Roots of trees compete for water, their crowns for light. Rats compete with men for stored grain. Competition is, of course, most severe between those living things whose requirements are most nearly alike. It should therefore be most severe within a single species—among wolves for meat and cattle for grass. It is often bitter and deadly among men. On the other hand there is generally within the species a pattern of behavior, even of coöperation, which leads to an adjustment. In nature one sees this in the beehive, in the spacing of trees in the forest, or in the nesting patterns of birds. Today man faces the problem of achieving a similar adjustment, using rational means. If unchecked, the outcome of human competition is war and destruction. Not infrequently such war destroys the very thing for which the groups are competing. Some measure of this may be had when we realize that a single shot fired from one of the largest modern cannon may cost as much as a simple dwelling house for a family of three.

TURNING A BARREN PLAIN INTO A PARADISE FOR WATER BIRDS



The dry prairie shown in the first picture barely supported a handful of sheep. But there was a small stream running through it. A dam in this stream sent its water flooding over the flat land. Like magic the earth turned into a green marsh. The second picture shows the wild rice growing higher than a man's head. Next we watch the arrival of thousands of waterfowl. And finally, as proof of the value of this work, we see the first brood of Canadian geese hatched out in this new bird refuge.

To these five general principles of ecology others might be added; and they all might be stated very differently by different workers. Even so, they seem to indicate clearly enough two important practical conclusions for people of today.

IV. SOME PRACTICAL CONCLUSIONS

The first is this: Man has destroyed the communities of nature and is attempting to set up his own. He must study the principles which govern communities in nature if his own new ones are to be permanent. In his new task of redesigning the landscape, he needs the assistance of ecology. And, like the ecologist, he must think less about "conquering nature" and more about learning how to work with nature.

In the second place, man must realize his interdependence with the rest of nature, including his own kind. He must find ways of controlling and adjusting the eternal process of competition so that he will not destroy the means of his own existence.

What Can We Do?

Climate.—We cannot change climate except on a small scale by making a windbreak or building a greenhouse. We can, however, fit our activities to the pattern of climate. This means producing plant and animal materials in the climate best suited to them and managing our farms and other lands to fit the average climate in a place instead of the exceptional. There are places where late spring frosts kill the peach blossoms five years out of six. In such places man ought to grow something else and give up his peaches. The serious dust storms of the 1930's were due to the fact that land was plowed up in wet years to grow wheat and blew away in the dry ones. Much of it should have been left in grass.

Soil.—Soil is the result of the prolonged activity of living communities; it is also a measure of the capacity of an environment to support life. It forms very slowly—perhaps an inch in 500 years—and may be lost very rapidly—an inch in a single rainstorm. Therefore it is necessary that man should plan his use of the soil so that it may be kept in place and improved instead of being lost or destroyed. There is also a difference in the fitness of various soils for specific purposes. It is not wise or economical to use a soil for the wrong purpose.

Water.—Like soil, water is a measure of the abundance of life. The moisture supply depends not only upon the amount of rain but upon the amount that is kept where it falls. Many of man's activities in building roads and drainage ditches, in destroying the forest and the grassland, and in mishandling his plowed fields cause the water to run off, first bringing on

floods and later dryness. Furthermore, this running water carries the rich soil with it. From this it follows that man should study the movements of water and contrive to handle them in such a way that this water will do him the most good. (*See also* Floods; Drought; Land Use.)

Living Communities.—The communities which man establishes consist of a few kinds of plants and animals, frequently managed in such a way as to injure the environment. The natural communities which they replace generally improve the environment. Furthermore, these natural communities—notably forests and grasslands—yield many products and sources of pleasure to man. The fact that a great deal of land formerly cultivated is now lying idle and useless suggests plainly that it ought to be restored to the natural communities which once occupied it. Perhaps also by studying natural communities man will learn how to improve the artificial communities represented by his fields, gardens, orchards, pastures, and barnyards. The insect-eating native birds which breed in the natural community represented by an uncut patch of trees or bushes are among the farmer's most useful helpers.

Competition.—The most bitter competition, as was said above, can be between members of the same species whose requirements are most nearly alike. That this can happen among human beings is evident from the relentless conflicts of the business world and of the battlefield. But the various species of plants and animals also have ways of getting on together with others of the same kind which lessen the evil of competition. The obligation upon man to take similar measures should be clear. Among the most powerful instruments at his disposal are scientific understanding of his ecological problems, coöperation in solving them, and a spirit of mutual good will. (*See also* **Ecology** in FACT-INDEX at the end of this volume.)

The PRODUCTION *and* DISTRIBUTION *of* WEALTH

ECONOMICS. Imagine that we should be shipwrecked with a group of other people on a fertile but uninhabited island, with the prospect that none of us will get off for a long time. We would find it necessary to make a living by using the resources of the island with the aid of whatever tools we might have been able to bring ashore.

Thinking how such a group would plan and work is helpful in understanding economics, because economics studies the ways in which people plan and work together to secure things that gratify their wants—that is, to secure the goods and the services which make up what we call "a living."

It is a mistake to think of a living in too narrow or restricted a sense—as including only our food, clothing, and shelter. A living, as the economist views it, includes much more: for example, concerts or plays enjoyed at the theater; the baseball games we pay to see; journeys by motor, train, and boat; the doctor's advice, the dentist's services; the policeman's protection against violence, the work of the fire department; the services of public schools, of city milk inspectors, and of street-sweepers. It includes all the things material or intangible which we work to obtain as we pass through life.

Some very few of the things which go to make up our living we obtain without any effort. It costs us nothing to enjoy a fine view of the moon, or the comfort of warm sunshine, or of a spring wind; but most of the things which go to make up a living must be striven for. These are called economic goods, and the striving for them is called *economic activity.*

The Materials of Production

If we continue to imagine ourselves as part of a shipwrecked group, we can easily see that there are many problems which concern people in their task of making a living. If we were in such a group, we would at once begin asking ourselves: Is there a supply of good drinking water? Is the soil likely to produce good crops? Is the climate such that protection from heat or cold will be important at certain times of the year? Is there a supply of timber which may be used for buildings or making implements? Are there mineral resources of stone, iron, or copper? A very important immediate question would be: Are there wild animals, or birds, or shellfish, or fruits, or nuts, or berries which may be used for food supply? An economist thinking of these problems would ask: What are the natural resources of the island? For economists give the name *natural resources* to the useful materials which nature supplies.

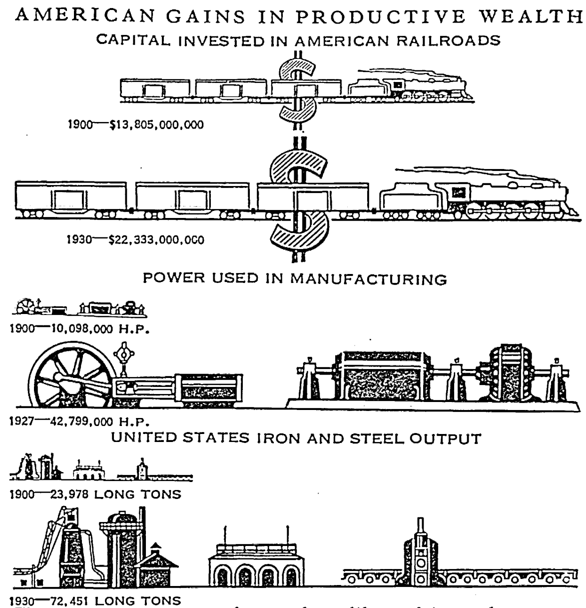
Implements of Production

Other questions that we would surely ask, if we were on the island, would be: Has anyone a gun? What is the community's supply of knives and compasses? Has anyone brought ashore spades, or hoes, or axes, or matches, or flashlights? All such things would be very helpful to the members of this pioneer community in using the natural resources which they found. In the economic life of a developed society like the one in which we actually live such implements are also useful. Even more useful are other forms of tools, such as railroads, electric power plants, paved streets, hard roads, office buildings, factories, and many other forms of equipment which we have constructed to help us turn natural resources into goods to gratify our wants. The economist, whether he were describing the situation on the island, or in the world at large, would use the term *capital* to designate all the implements used in converting natural resources into consumable goods. Capital is defined as goods made in the past and used, not for consumption, but to make more goods.

Another question which would be very important to us, if we found ourselves on the island, would be the question of man power. If all of us were very old

and feeble, or very young and inexperienced, our chances of being comfortable, or perhaps even of staying alive, would be poor. We would be more likely to be happy if our group contained a good proportion of youth and strength, of maturity and wisdom, and of persons who had special skill in building, farming, hunting, fishing, cooking, caring for the sick, organizing, and planning. Considering all the physical and mental ability of our group as a single quantity, we may call it the *labor power* of our community. Labor power is the term economists use to name the working ability of the people of a nation or of the entire world.

Every factor which we have seen to be of importance on the island is important in the economic life of a community, of a nation, or of the people of the whole world. The basic factors of production—those things which are of fundamental importance—are *natural resources, capital equipment, labor power.* During all of our lives everything that we may hope to obtain as a social group must come out of these resources. It is not strange, then, that wars have been fought to possess land, or coal-fields, or iron mines, or to conquer people for the sake of exploiting their labor.



Here we see how some forms of wealth used to produce more wealth increased during two census periods.

As time goes on, we are making certain improvements and perhaps suffering certain losses in these three factors of production. In the United States, for example, the people have used up a great deal of the timber supply; they have made considerable inroads on the deposits of coal, iron, and copper; and they have consumed large quantities of the natural gas and petroleum. On the other hand, the people have expanded their available natural resources greatly by discovery and invention. When the West was opened it gave vast new farm lands. The discovery of coal, iron, copper, and gold added to the physical resources. Quite as important are the discoveries that have been made in the fields of chemistry and physics. When the steam engine was invented, for example, the resource of the expanding properties of water as it turns to steam added untold value to the supply of Nature's gifts. Achievements in the fields of electricity and radio have tapped other resources undreamed of a few generations ago. In the capital equipment of the United States additions have been vastly greater than losses, as the picture herewith shows, although fire and flood and wind and earthquake take a toll each year, and wear takes a larger one.

American labor power has also increased, partly as a result of growing population and partly as a result of education, which has taught men how to work more effectively. In the early days of the United States an increasing population was important. A larger population could make better use of the varied types of physical resources in the United States, and there could be better specialization for producing various types of goods. It is very doubtful, however, whether the United States now gains by further increases in population. As population has increased, it has become necessary to utilize not only the best soil and other natural resources, but much that is of second and third grade. When such resources are utilized, there is not as large a return per person as is the case when only the better grade is used. As the population has to apply itself to poorer lands, and to coal and other minerals which are deeper in the earth or farther from factories, there is a strong force at work tending to make the average income less than it would be if the population were smaller and applied itself only to the better resources.

It is of great importance to production that society's materials—natural resources, capital equipment, and labor power—should be brought together and related effectively if society is to secure the greatest quantity and highest quality of economic goods. The task of planning how natural resources, equipment, and labor power shall be combined, is the task of *organization.* Wherever people are found working in groups, organization is to be found. Even on our imaginary island we should probably elect a president or a general manager who would plan and direct the work of the others.

The Organization of Economic Activity

There are several ways in which the work of organizing our economic activity is carried on. A little of it is done by families and a little by clubs and other such organizations. But there are two methods which are important far beyond any others. The first may be called *organization by individual enterprise.*

This simply means that we permit people who wish to organize part of our economic activity to do so. If a man or woman thinks there should be a new store, bank, furniture plant, or automobile business,

he or she may organize one. He is free (though with certain important controls in some lines of business) to put together the necessary natural resources, labor power, and capital equipment, in the way that he decides is best. Every head of a business is an example of an "enterpriser" (or *entrepreneur*, as French economists call him), who is taking some responsibility for organizing our materials and producing some of the things that people want in making a living.

Public Enterprise or Government

A second way of organizing is by *public enterprise*. We have our national government, our state, county, city, township, and other governments, which are formed by groups of people as ways of getting things done. Indeed, a government has no real purpose unless it is a sort of committee by means of which a larger group works to carry on economic activity.

Some persons believe that it would be a good thing if we did away with the practise of permitting business and professional men and women to act as organizers, that is, if we did away with individual enterprise, and carried on all of our economic activity by means of public enterprise. If we did this, our governments would organize factories, stores, railways, warehouses, doctors' services, and insurance just as they now organize public school education, public health service, the mail service, the road and street system, and the army and navy. The carrying on of economic activity by governments, particularly if the governments also own the materials used, is usually called social economic activity, or Socialism (*see* Socialism). The chief examples of social economic activity in the United States are the mail system, the public schools, and the army and navy. In Russia at present practically all economic activity is directed by the government (*see* Russia).

Forms of Private Enterprise

While public enterprise organizes *governments* as devices through which to work, private enterprisers organize *businesses*. Thus:

1. *Individual enterprisers* do the larger part of our organizing—
   a. By going into business. Examples are storekeepers, bankers, and farmers.
   b. By going into the professions. Examples are doctors, dentists, and lawyers.
2. *Public enterprise working through governments*—
   national, state, and local—does a considerable part of the work of organizing. Examples are the public schools and the postoffice.

There are three chief forms of business organization. These forms are the individual firm, the partnership, and the corporation. The individual firm is a business organized and conducted by one man, who uses in his business such funds as he can furnish or borrow, and who employs such assistants as he needs. Most small businesses are individual firms. The partnership is a form of business organization which rests on an agreement made between two or more persons that they will carry on business as partners. Sometimes all contribute money; sometimes some contribute money and others work; and sometimes all contribute money and work. They share in the earnings of the company according to the agreement made. A corporation is defined at law as a legal person which, though it has no flesh and blood, can make agreements, borrow money, and hire employees just as a real person does. Corporations are organized by the authority of the government, which grants corporate powers upon application properly made by a number of persons acting as incorporators. The corporation is managed by a president and other officers. The ownership of the corporation is divided at the beginning among the incorporators and others who have subscribed for shares in its ownership. (*See* Corporations; Stocks and Bonds.)

The individual firm is useful where the economic tasks undertaken are small in scale so that they can be looked after by one man and financed with comparatively small means. A partnership may be desirable where more funds are needed and where partners can each contribute some kind of specialized skill. The corporation has become the most important form of business unit, because it makes possible, chiefly through the sale of stock, the amassing of the enormous amounts of money needed for modern manufacture, transportation, and banking, and because its work, unlike that of the other forms, is not interrupted by the death of partners or proprietors.

The Guidance of Economic Activity

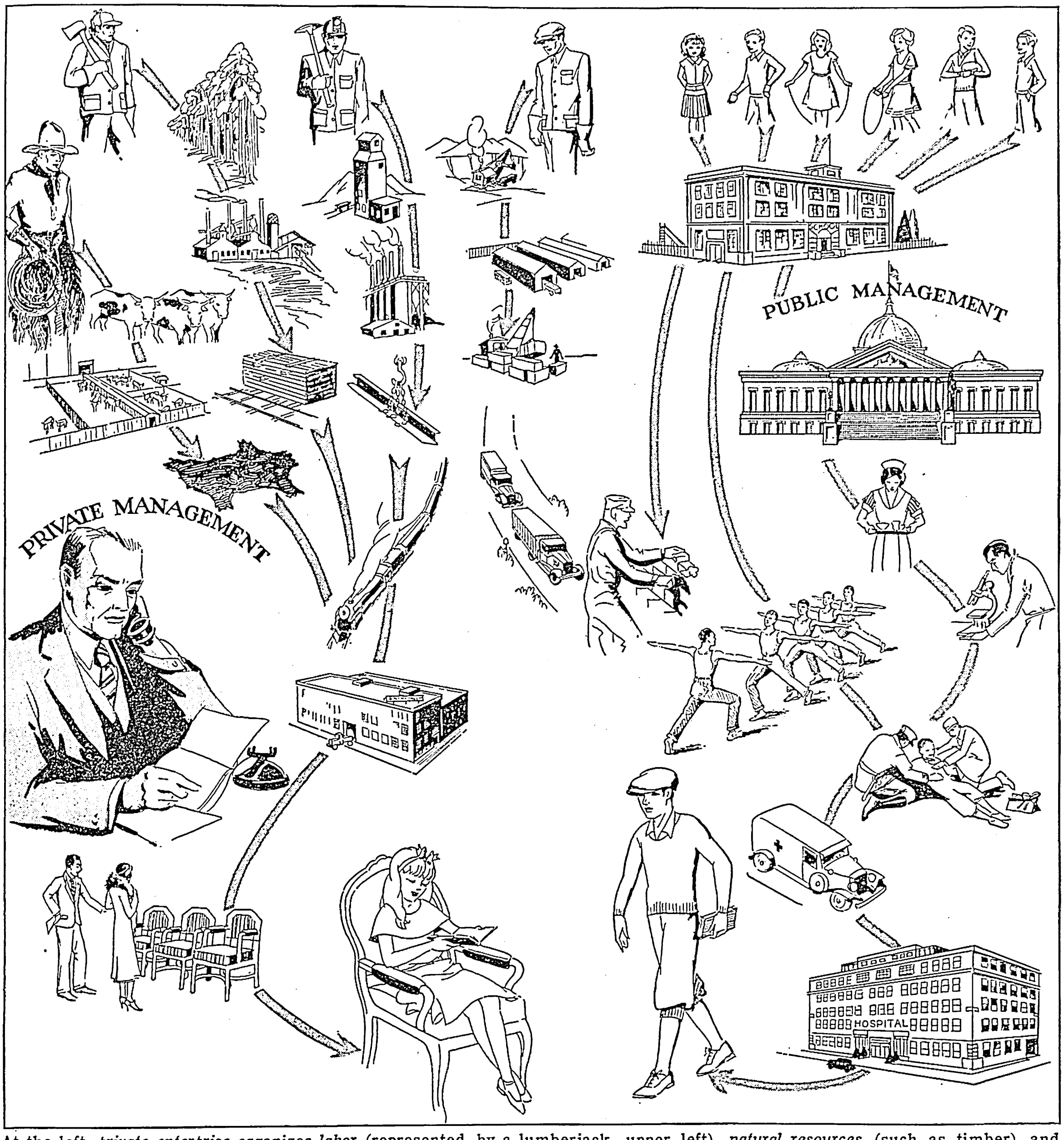
How do business men and governments decide what things should be produced and made available to consumers? Put in another and perhaps a larger way the question is, How is economic activity guided?

To answer this question we must first realize that our social materials are limited. There are not enough available at any one time to make all we want of everything. Nor is it desirable to use our resources at any given time to make only the things we want at the moment. Some raw materials, some of our labor power, some of our equipment, should be employed in keeping up and improving our productive resources so that we may get a good supply in later years.

This is not all the task, for we must not only decide between present goods for consumption and the keeping up and improving of our equipment, but we must also decide what kinds of goods to make at present—how many shoes, how many overcoats, how many hats, how many houses, how many textbooks, how many pianos, and the kinds, sizes, and shapes of each of these. And in building for the future we must decide how many railroads, how many factories, how many paved streets, how many office buildings, and what kinds, sizes, and shapes of each of these we can use.

How do governments and business men decide these questions? Those who are responsible in governments—congresses, legislatures, and boards of aldermen—usually decide by considering those things which they believe it would be socially desirable to have. On that basis it is decided that we will have public schools, public parks, a sewer system, and

HOW BUSINESS MEN AND GOVERNMENTS ORGANIZE HUMAN EFFORT



At the left, *private enterprise* organizes *labor* (represented by a lumberjack, upper left), *natural resources* (such as timber), and *capital* (such as a sawmill), to produce wood and other needed materials; then, by factory manufacture and store sale, it places the chair at your disposal. For this you pay the sales price of the chair. *Public enterprise* meets other needs by training and maintaining policemen, doctors, nurses, schools, hospitals, and other agencies to help in case, say, of accidental injury. This is paid for by the people in the indirect form of taxes levied upon incomes and property of various kinds.

lighted streets. Business men, however, act on a different principle. They make what they believe will pay best. For this reason it may be said that our economic system, so far as business is concerned, is guided by the *profit motive*.

How does a business man know what will pay best? He does not always know. He makes the best estimates he can by means of market analyses to determine what goods people will buy, in what quantities they will buy them, and what prices they will pay for them. Then by cost accounting and other methods he determines as well as he can the cost at which these goods can be produced or purchased, and he decides to manufacture or buy and sell those which it appears to him will be most profitable. Of course, if a man is once in business, if he has built factories and made contracts for materials and equipment, he cannot always shift easily from one line of production to another. Nor are all business men interested only in what pays best. Some have taste

and knowledge which influence them in their choices as much as gain. But it is no mistake to say that the chance for profit is the most significant and far-reaching motive of business men.

It is not only the business man who is influenced by what pays best. When a business man or a government has determined that a certain thing—shoes or public parks—shall be produced, the social materials which will produce them must be obtained. Although these are called social materials, most of them are privately owned. In some cases governments can get materials in part by force or through sentiment. In war, which requires a stupendous apportionment of society's materials to the making of armies and munitions, the Federal government secures men by draft or voluntary enlistment. But except in such emergency cases, governments and business men alike must resort to the process of payment.

The Return from Capital

Persons who own a natural resource or capital equipment will sell or lease it to the highest bidder. If they lease it, the return they receive is called *rent.* If they lend the curious form of capital called *money,* the payment is called *interest.* Persons with their own services to sell will work where conditions are best or salaries highest, or both. Their payment, in return for their "time" capital, is called *wages.*

Thus the profit motive is important in influencing the owners of tangible things as well as the owners of labor power to put the social materials which they control into making one thing or another. Guidance in our business system is often said to be *pecuniary guidance,* because the persons concerned count in pecuniary units—dollars—the relative advantages of doing or making one thing as compared with another.

Each of us as a consumer has a sort of vote as to what we would like to have business make. We vote with the dollars which we spend, but we do not have equal votes. Those who have larger incomes have more votes than those with smaller incomes. If the old phrase "money talks" has meaning anywhere, it has it in the guidance of economic activity, for to profits as expressed in dollars the business man and the owners of the factors of production listen closely in making their decisions.

Financial Institutions of Our Economic System

Obtaining the funds necessary to induce the owners of natural resources and equipment and labor power to furnish these is one of the most difficult tasks of both businesses and governments. Businesses secure their funds in several ways. A man may have saved enough to begin a business as an individual firm. Several men with savings may, as we have seen, join to form a partnership, or subscribe for stock in a corporation which they wish to organize. In any type of business, profits may be made from operations, and these may be employed to expand the activities. If still larger funds are believed to be necessary, a business borrows. When a business wishes to borrow, it turns for aid to other firms which are in the business of lending money. Among the important types of these financial institutions are the commercial bank, the investment bank, and the stock exchange. The *commercial bank* lends money for the daily uses of business men in trade and commerce, using partly its own funds, and partly those deposits which have been made by storekeepers, factory owners, you, me, and others who have "put our money in the bank." Commercial banks usually loan only for brief periods, although they may renew a loan many times. (*See* Banks and Banking.)

A second source of funds, particularly for corporations, is the *investment bank.* Such a bank makes a business of securing funds needed for a longer period than the commercial bank is willing to lend. A corporation dealing with an investment banker prepares bonds, printed or engraved, which are signed by the proper corporation officers. The investment banker buys these and thus supplies the corporation with the needed funds. The investment banker, in turn, sells these bonds to investors at a price higher than he paid.

The Function of Exchanges

The *stock exchanges* in New York and other large cities are of great importance in providing funds for business, because they serve as market places where bonds and stocks may be sold. People are more willing to lend money to corporations, that is, buy the bonds of corporations, or to buy their shares, when they know there are markets in which they can sell these securities if they wish.

The ability of corporations to secure large funds through issuing stock and through borrowing has led to certain serious problems. Many people are concerned because these companies thus obtain control over such a stupendous amount of capital that they can exercise far-reaching power, which may be viewed as dangerous. The movement toward great concentration of wealth was earlier called "the trust movement." It is now also commonly referred to as "the merger movement." (*See* Trusts.)

To some extent, governments secure their finances by the same method which private businesses use. They borrow from banks and issue bonds. They have one important method of securing funds, however, which private business may not employ. This is taxation. Taxes make up the largest single factor of government income. (*See* Taxation.)

Modern Production: The Mass and Machine Method

With natural resources, capital equipment, and labor power purchased, businesses or governments may proceed to production. It has now become generally recognized that in economic operations—both of business and government—there are usually economies in large-scale production, or so-called "mass production." The chief saving comes because power and machinery can be applied most effectively to performing over and over again the processes called for in such production. As a result, most modern factories and power plants are repositories of vast machine equipment. The extensive use of machinery,

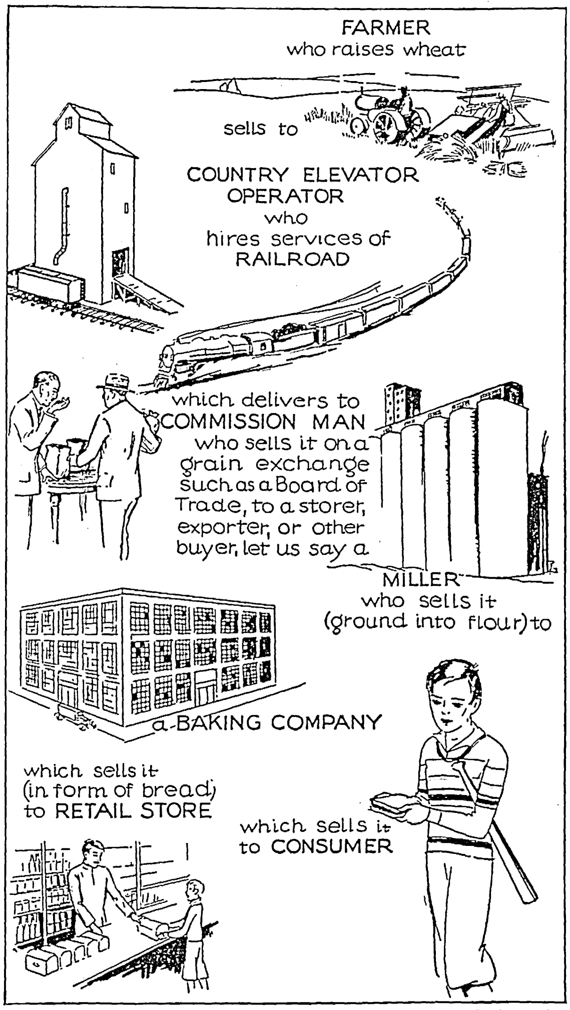
although enormously productive of goods, involves undesirable factors. First is the risk involved in large investment in a fixed form. If a new invention makes an old machine useless, the investment in the machine may be lost. If a change of styles causes consumers to refuse to purchase the goods formerly produced by a great factory, its owners may find that its great machines represent merely a financial burden. For the workers, also, machines have made serious problems. First of all, a machine by its very efficiency puts men out of work; and although such unemployed persons may eventually find new places in the economic system, they do so often only after serious privation and suffering. The building of great factories has been responsible also for much of the concentration of people into crowded cities; and this in turn has given rise to many questions involving health, behavior, education, and government (*see* City). Machines each year cause an appalling number of industrial accidents and deaths, and, with their noise and monotony of operation, bring fatigue and nerve strain in labor. The good and the bad features of machine production exist whether the machine is employed by private business or by government, whether in an economic system of private enterprise, or in a socialistic economy.

Specialized Production

Few single enterprises, whether private or governmental, whether farms, factories, or stores, attempt to perform all the processes necessary in making goods for consumers. The farmer raises wheat, but it is hauled to a large city by a railroad, ground into flour in a mill, baked in a large bakery, distributed by trucks to retail stores, and there sold to housewives. Production of bread requires all these steps, and production is not completed until the bread is ready to be consumed.

This dividing of the task of production, among many units, which is common in our economic world, is called *specialization of economic units.* Still further specialization exists within each one of the specialized business or governmental units. This division of labor among specialized units would not be possible if they were not related or organized in some way. Yet there is no general management of all of them. They are integrated only by the agreements which they make in buying and selling among themselves.

THESE PEOPLE PROVIDE YOUR BREAD



Here are only a few of the steps taken by many people in order to furnish the world's bread. The example is worth noting, because it illustrates the process when a commodity exchange enters into the system.

This great amount of buying and selling takes place in part in very highly organized markets and in part in very informal ways in men's offices, or by letter, telegram, and telephone call. In some cases the factors of competition are ever present and force prices up and down as supply and demand dictate. In others there is much less competition, and sellers are sometimes able to secure much higher prices than would be the case if competition were more keen.

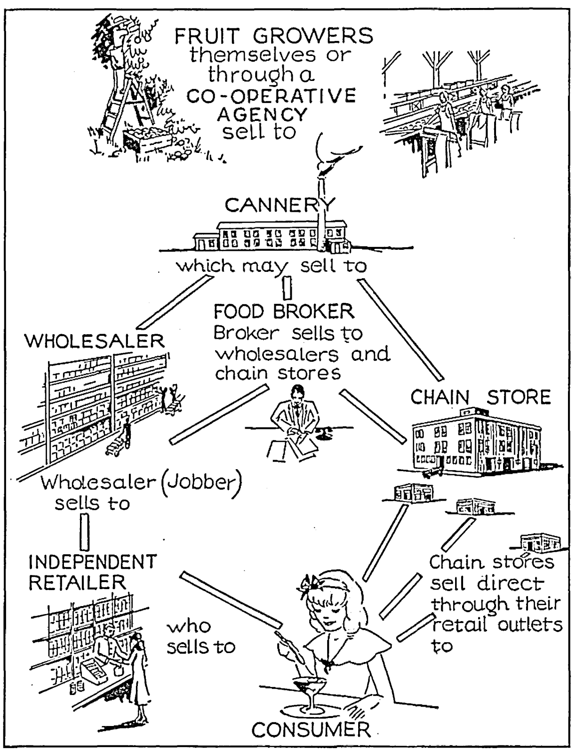
The Work of An Organized Market

Buying and selling are so important in tying our production into a system that at least one important type of market should be described. There are few markets better organized than those called the "commodity exchanges." One of the largest, dealing chiefly in grain, is the Chicago Board of Trade, where many millions of bushels of wheat, corn, and other grains, are sold each year. Any farmer, country elevator operator, or other owner of wheat may send grain to a proper agent at this or any grain exchange (there are important North American ones in Minneapolis, St. Louis, and Winnipeg) and have it offered for sale. The grain, which usually comes in carloads, is tested and graded by government inspectors Samples are placed on tables; buyers examine them; and sales are made to those who offer the best prices. All exchanges are in continuous touch by telegraph. As orders for wheat for milling purposes, for exporting, and for storing are sent from all parts of the country to agents in the various large markets and,

indeed, from all parts of the world, there is brought to bear on the grain shipped into the organized markets on any given day the world's demand for grain on that day. The prices in different markets are kept close together by inter-market selling called "arbitrage" (*see* Boards of Trade). Thus any seller, even of a single car, is reasonably assured of securing in any market as much as is justified by the world demand on that day.

In deciding what prices should be paid for grain on any given day, buyers and sellers also consider the supplies which may be available later. Such supplies can be considered because of a far-reaching service of the Federal government in gathering information about stocks of grain in the hands of farmers and other storage points both in the United States and in other parts of the world. Even the promise of crops now growing but unharvested, and the prospects of crops yet to be planted, as these are shown by weather and soil conditions, are included in the reports made.

HOW CANNED FRUIT REACHES YOU



Many of the steps above are similar to those for supplying bread, shown on the preceding page—but here there is no commodity exchange in the process.

On the large grain exchanges there is a market not only for grain actually shipped in on a given day (called "spot" grain) but also for grain to be delivered in the future. On this market one may sell at a definite price but for a delivery in some future month. Prices in this market are also determined by buyers and sellers who consider factors which are to be effective in the future.

Because the grain exchanges furnish places at which the supply of grain and buyers for it are concentrated, the thousands of producers of grain need not hunt for customers. They need only send their crops to the central markets. Selling costs are, therefore, comparatively low. The futures markets, in addition, forecast what the most critical judges believe will be the price some months hence. A buyer or seller is thus guided in determining whether he wishes to sell immediately or in the future. The futures markets are also of value to producers who are considering putting in seed for new crops, for by seeing the probable price in the future, the grower is better able to estimate the chances of profit. Similar services are provided for other commodities, such as cotton and rubber, by their individual exchanges.

If one follows wheat along toward the consumer, he will not find another market so well organized as the grain exchange. When the miller offers flour for sale, it is often under his own brand; and when the baker offers bread, the same is usually true. Both (as do many other manufacturers, of course) strive by advertising to persuade the consumer that their brands are best. Such advertising seldom reveals the intrinsic qualities of the goods, as does the government testing on the exchanges. Among the many questions which need careful thought in our economic organization is that of arranging that the buyer may know what he is buying and how to make some comparison of its merits with those of other available goods.

The Distribution of Social Income

When materials have passed from the farm, the mine, or the quarry, and perhaps through the factory, the wholesale warehouse, and the retail store, they come to the consumer as "produced goods." But how many shall go to each consumer? What division shall be made of all the goods and services produced by governments and businesses? How much shall each of us receive? As an economist would put it, what shall be the *distribution of social income?*

Light is thrown on distribution of both governmental production and business production by what was said earlier concerning guidance. Governments produce public school systems. They are available on equal terms to all. Thus one might say that in a sense they are equally distributed. It is not true, however, that all are equally benefited, for an old man with no children may pay heavy taxes, whereas a young couple with several children may have very small taxes. A city provides fire protection without charge, but some persons own many buildings which need fire protection, whereas others have none. In all such cases we may say that governments distribute to each according to his need so far as they distribute to any.

When we turn to distribution of goods produced by business in our economic system, we find a different picture. These are not offered free of charge, or according to need. They are offered in quantities and

qualities according to our ability to pay. What each one gets, therefore, as his share in the distribution of the products or goods produced by business, is what he is able to pay for. What any one of us is able to pay for depends upon what we have.

What we have at any moment is the result of what we have obtained in such ways as inheritance, marriage or gift, or by saving from *income*. Income may be in the form of wages (payment for work), or interest (payment for funds used), or rent (payment for other resources). Either rent or interest may be paid to us with no relation to our work. Wages, in turn, depend upon many factors. Among them are the capacities with which we are born, our health, our education, our acquaintances, our industry, our perseverance, as well as accidents and "tricks of fate" over which we have no control.

These, then, are the basic ideas of economics. Most economists are interested not only in studying the processes described but also in considering possible ways in which all of these processes can be improved; they are desirous of finding methods whereby the distribution of what is produced can be brought into better accord with current ideas of justice. (For a list of terms commonly used in economics, and in business generally, *see* Economics in the Fact-Index.)

—REFERENCE-OUTLINE *for Organized Study of* ECONOMICS—

FUNDAMENTALLY all wealth comes from taking things that are in the earth and turning them into things that are of use to man, such as food, clothing, or even works of art. Economics is the science that studies the development of natural resources, and the production and distribution of the resulting wealth. Since almost everything that man does has an economic significance, economics forms the background for a vast web of interrelated subjects.

In the beginning economic life was very simple, for the primitive peoples supplied their own needs, and had but little left over for trading with other peoples. But as civilization advanced and trade developed, the economic life of the people became more complex, although many of the necessities like clothes and food were still produced by the people that used them.

The Industrial Era, brought on by the invention of the steam engine, produced great changes in the "economic structure," and made it extremely complex. Now everyone is dependent on the activities of other people for nearly all of the necessities of life. (*See also* the Reference-Outlines for **Sociology, Political Science, Industries and Industrial Arts,** and **Agriculture.**)

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Note: Once the Industrial Revolution was well under way, it led to the rapid development of industrially useful inventions in many fields, such, for example, as the Telegraph T-30, the Telephone T-34, the Electric Light, the Electric Generator, and the Electric Motor E-233, E-215, the Gas Engine G-19, Automatic Machinery A-384, etc. All of these in turn magnified the effects of "industrialism."

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LAND *of Tropic* HEAT *and Perpetual* SNOW

ECUADOR (*ĕk'wä-dôr*). The small republic of Ecuador, on the Pacific side of South America, gets its name from the Spanish word for *equator*. Though no part of it lies far from the Equator, it is traversed from north to south by the lofty Andes Mountains. Hence it shows amazing contrasts of scenery. It has snow-covered peaks towering from 15,000 to 20,000 feet; high cool valleys; and hot lowlands, some of which are barren wastes and others are dense jungles.

The Land and the Climate

The two ranges of the Andes here are so near each other that some geographers prefer to speak of only a single range. This mountain barrier makes transportation difficult. It so isolates the eastern and western portions of the country that they have little intercourse. On the other hand, it gives Ecuador an advantage possessed by no other equatorial region of the world, except, to a lesser extent, by Kenya Colony in Africa. On its cool and healthful plateaus and in its fertile valleys white men can live in comfort the year round.

Ecuador claims an area of about 276,000 square miles, but of this about 125,000 square miles—the great Amazon region east of the Andes between the Marañon and Napo rivers—are also claimed by Peru. This region of mountain slopes and swampy lowlands is heavily forested and is inhabited mostly by Indians. Its possession has been in dispute for more than a century. Ecuador also possesses the Galápagos Islands (2,400 square miles) on the Equator 600 miles to the west. The islands, which take their name from the giant land tortoises (Spanish *galápagos*) that inhabit them, are one of the most interesting natural areas in the world. Charles Darwin's study of them profoundly influenced his theory of evolution. (For map, *see* Peru.)

The high valleys and plateaus, where most of the people live, are from 7,000 to 9,500 feet above sea level. Their united length is about 300 miles, divided by cross ranges. Much of this region is suitable for agriculture. On the Pacific side of the Andes is a broad coastal region. Here are the only considerable group of navigable waterways and the only important gulf—the Gulf of Guayaquil—on the whole Pacific coast of South America. The Guayas River, which enters the gulf from the north, with its tributaries, drains a large part of this region.

Forty miles up the Guayas is Guayaquil, the gateway to Ecuador and its chief port. Nearly 300 miles to the northeast—a two days' journey by rail up the steep slope of the Andes—lies the quaint old capital, Quito (population, more than 100,000). Although the city is within 15 miles of the Equator, it is nearly two miles above sea level and consequently has a climate of perpetual spring. One season is so like another that planting and harvesting go on side by side. The mountain pass leading to the plain of Quito is guarded by more than 20 snow-clad peaks, several of which are volcanoes. Here stands the majestic Chimborazo (20,702 feet), long supposed to be the highest peak in

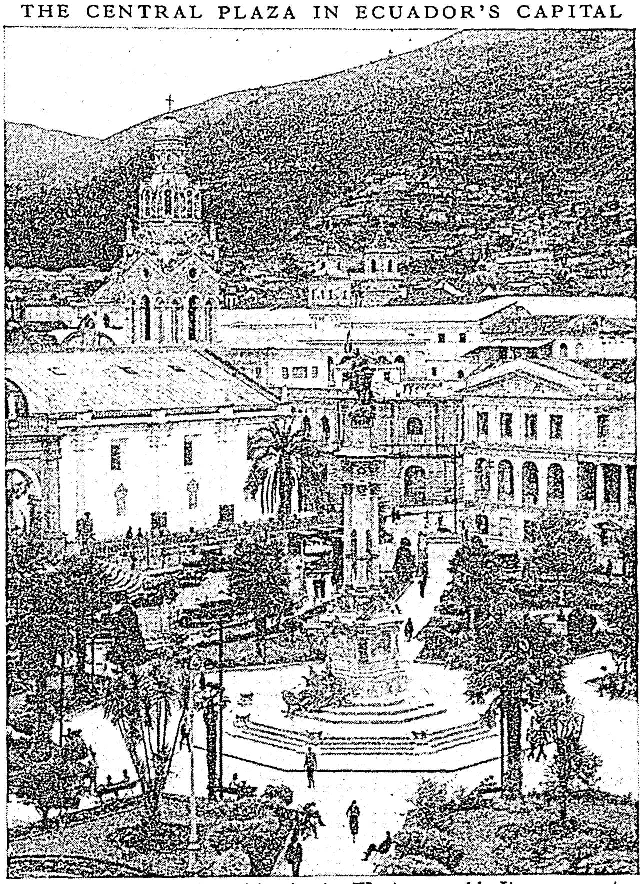
the Andes. Near by is Cotopaxi (almost 20,000 feet), the loftiest active volcano in the world.

The climate, because of the varying altitudes, ranges from tropical heat in the lowlands to Arctic cold on the high mountain peaks. The rainfall is heavy in the eastern lowlands and abundant on parts of the west coast. Hence these regions are forest-covered and fertile, and teem with animal life. Most of the coastal region of Ecuador thus presents a sharp contrast to the arid coasts of Peru and Chile to the south. At Quito in the highlands the annual rainfall averages 44 inches, about half that of the Amazon Valley. The rainy season comes between September and May.

The People and Their Industries

Including the disputed territory, Ecuador has an estimated 2,800,000 inhabitants. About a third of these are Indians, and about one-half are *mestizos*, of mixed Indian and white blood. The whites, numbering only a tenth of the population, occupy the important places in government and industry and control most of the land. This system of land monopoly has retarded the country's progress. The mestizos and Indians, who labor on the great estates, live in abject poverty. About three-fourths of the population is illiterate.

THE CENTRAL PLAZA IN ECUADOR'S CAPITAL



Quito is one of the oldest cities in the Western world. It was a center of Indian culture long before the Incas in the 15th century made it one of their four district capitals. On the Plaza Mayor, shown above, stand the cathedral and the principal government buildings.

Only about 2 per cent of the land is cultivated. Cacao beans, grown on the lowlands of the coast, are the major crop and account for about a third of the exports. The palmetto fiber used for Panama hats is another important product, since Ecuador supplies most of the world's Panamas. Minor export crops of the coastal region include coffee, cotton, rice, and tropical fruits. Quantities of the nuts of the wild tagua palm, called vegetable ivory and used for buttons, are shipped; and balsa wood is exported.

In the high mountain valleys, wheat, potatoes, corn, barley, and other food crops are cultivated for home consumption. Here, as well as on the coast, are pasture lands which support a growing cattle industry. Though the rich forests of the eastern lowlands are largely undeveloped, they have vast supplies of vegetable ivory, rubber, and balsa wood; and also of a tree whose seed pods contain the silky fiber called kapok, used to stuff mattresses (*see* Fibers).

Ecuador has little mineral production. Gold, silver, copper, iron, mercury, lead, sulphur, and platinum are found, but only gold is mined in important quantities. There are rich petroleum deposits, scattered over the country, and production is increasing with the introduction of modern drilling methods. The country manufactures textiles, shoes, and other commodities, but most of its manufactured goods are imported from the United States.

Both agriculture and industry have been retarded by poor transportation. Goods are carried across the ancient mountain trails on the backs of mules and llamas, owned by the *arrieros*, or Indian drivers. There are about 800 miles of railway. Airplane service connects Quito with the outside world. The Guayas, Marañon, Daule, and other rivers furnish several hundred miles of navigable waterways.

History, Government

In early times, Ecuador was inhabited by a number of semicivilized agricultural peoples. They built elaborate stone temples; made ornaments and implements of copper, bronze, and gold; and grew corn, potatoes, and other crops. Archeologists still know little of the origin of these peoples. A few years before the arrival of the Spaniards the whole country was conquered by the Incas, or Quichua (*see* Incas).

The modern history of the country has been unusually stormy. Conquered in 1534 by lieutenants of the Spanish adventurer Pizarro (*see* Pizarro, Francisco), it was administered under the Spanish viceroyalty of Peru. Efforts to shake off Spanish rule finally succeeded in 1822, when Ecuador became part of the republic of Colombia, under the presidency of the South American liberator Bolivar (*see* Bolivar, Simon). In 1830 it was proclaimed an independent republic. During the next hundred years the nation engaged in two wars, was ruled by a series of dictators, and had more than a dozen constitutions. The most notable constitution was that of 1906, which disestablished the Catholic church and divided power between the president, elected directly by the people for a single four-year term, and the congress, composed of a senate and a chamber of deputies. Following a

military revolt and seizure of power in 1925, there was a period of chaos. In 1938 a new constitution was adopted but a year later the constitution of 1906 was restored. (For further study of geography and culture, *see* Latin America; Latin American Literature; South America.)

EDDY, MARY BAKER (1821–1910). The distinction of being the only woman to establish a great religious faith belongs to Mary Baker Eddy, the founder of Christian Science. Born on a farm near Concord, N.H., Mary Baker was a beautiful but delicate child, thoughtful and deeply religious. In her early womanhood she married George W. Glover, and went to live in Charleston, S. C., but in about a year her husband died, and she returned to her parents' home.

For many years her health was delicate, and in her distress of mind and body she turned to the Bible for consolation. Gradually there came to her the conviction that God is infinite Spirit or Mind, the divine Principle of all real being, and that since He is infinitely good, there can be no real evil. What we call sin, sickness, and death are only errors of mortal mind, and when these errors are destroyed, mind and body are healed.

MARY BAKER EDDY
The Founder of Christian Science

"The falling apple," as she herself expressed it, which after 20 years of seeking led to the discovery of the Principle of Christian Science, was an accident from which she recovered in a seemingly miraculous manner. On the third day after her injury, when she lay apparently at death's door, she called for her Bible, and read the account in Matthew ix of how Jesus healed the palsied man. Then, in her own words, "As I read, the healing Truth dawned upon my sense; and the result was that I rose, dressed myself, and ever after was in better health than I had before enjoyed." ('Miscellaneous Writings', p. 24.)

This was in 1866. Then followed years of profound thought and study of the Scriptures, the results of which were given to the world in 1875 in her book, 'Science and Health with Key to the Scriptures', the textbook of Christian Science.

Among the little group of students who had gathered around her was a grave, sweet-tempered man named Asa Gilbert Eddy, whom she shortly afterward married. He lived only five years after this, but he was of great help to Mrs. Eddy in the early and troublous years of the Christian Science movement.

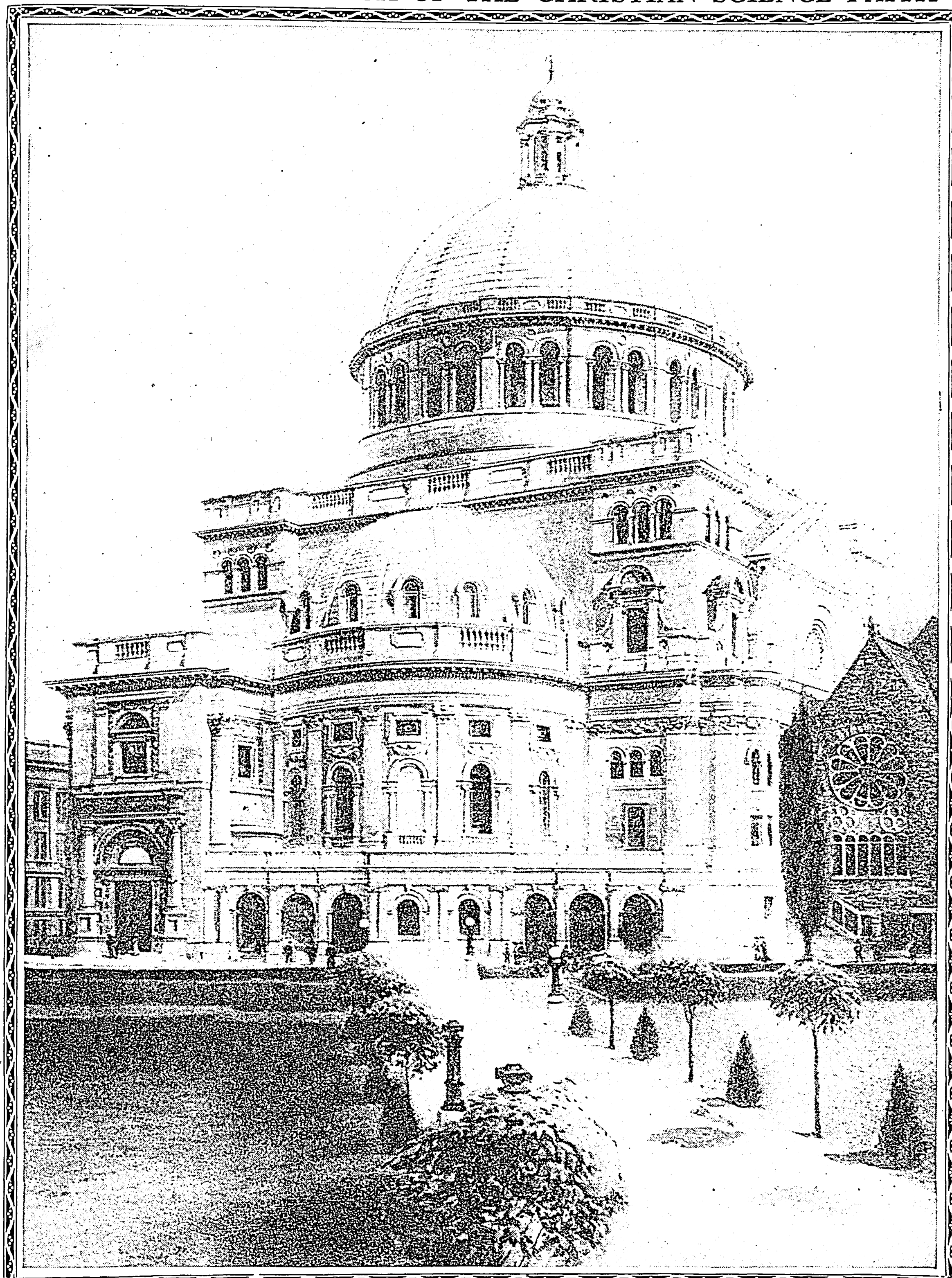
In 1879 Mrs. Eddy organized the church in Boston, which came to be called The First Church of Christ, Scientist. From this "Mother Church" branches quickly spread to all parts of the United States and even to foreign countries. For many years after her husband's death, Mrs. Eddy continued to lead a very busy life, teaching large numbers of students, editing *The Christian Science Journal*, and inspiring eager congregations. Her last years were spent at "Pleasant View," her home in Concord, N. H., and at Chestnut Hill in Newton, a suburb of Boston, Mass. She remained the active leader of the Christian Science movement until she quietly passed away on Dec. 3, 1910, in her 90th year.

EDINBURGH (*ĕd'ĭn-bŭr-ō*), SCOTLAND. Frowning Castle Rock, a bold precipitous height of 430 feet, dominates the capital city of Scotland, as the Acropolis dominates Athens. This circumstance, together with the city's intellectual and political prominence, makes Edinburgh's title "the Athens of the North" more appropriate than such nicknames usually are. The rock is surmounted by a massive medieval castle which was the ancient seat of the Scottish kings.

From this height you see one of the most picturesque scenes in all Europe. On three sides the rock drops sheer to the valley below. To the east along a narrow ridge runs "The Royal Mile" (High Street and Canongate) to Holyrood Palace, on the edge of King's Park with Arthur's Seat like a crouching lion. In this historic palace once dwelt unhappy Mary Queen of Scots and others of the Scottish royal line. To the south of the Royal Mile lies the quaint Old Town, familiar to all readers of Scott's romances. Many of the old houses which line the "closes" of this quarter are remarkable for their height—" bee hives ten stories high," as Robert Louis Stevenson called them. At the foot of Castle Rock to the north are the beautiful Princes Street Gardens, filling the narrow ravine; and beyond them rises the New Town, with its massive modern buildings and its splendid commercial streets. Princes Street, bordering the Gardens on the north, is accounted by many travelers as one of the finest streets in Europe.

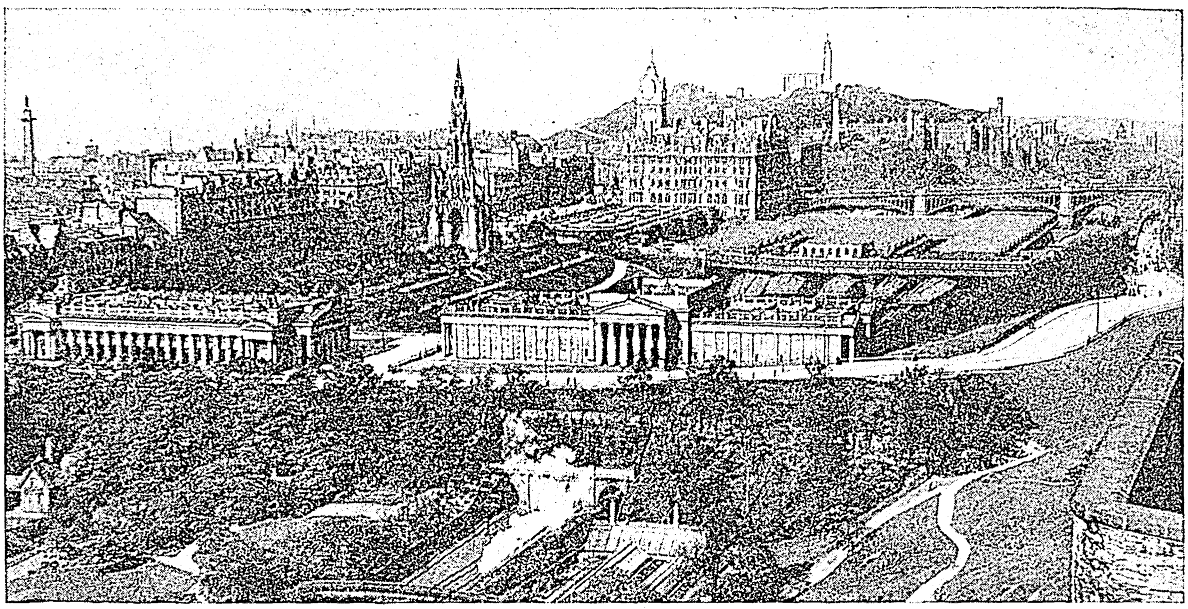
Reminders of a long and illustrious past everywhere meet the visitor's eye. In Queen Mary's room in the Castle was born James I of England (1566). In Holyrood Palace are many relics of the queen, and a brass plate in the vestibule of her audience chamber marks the spot where her favorite Rizzio was assassinated. In St. Giles's Church (built 1385–1460) John Knox, the great religious reformer, often preached; and not far away is the quaint old stone house with its projecting front where Knox once lived. The University, founded in 1582, is one of the most famous in Europe and the list of its members contains some of the most celebrated names in British history and letters. The Parliament House, once the seat of the Scottish Parliament but now occupied by Scotland's supreme law courts, is rich in memories of Sir Walter Scott,

THE MOTHER CHURCH OF THE CHRISTIAN SCIENCE FAITH



This magnificent structure in Boston is the mother church of the Christian Science faith. As you can see from the picture, it is one of the most beautiful buildings in America, and its architectural style has been followed in many of the Christian Science churches throughout the country. The full title of the church is "The First Church of Christ Scientist."

LOOKING ACROSS THE HEART OF EDINBURGH FROM CASTLE ROCK

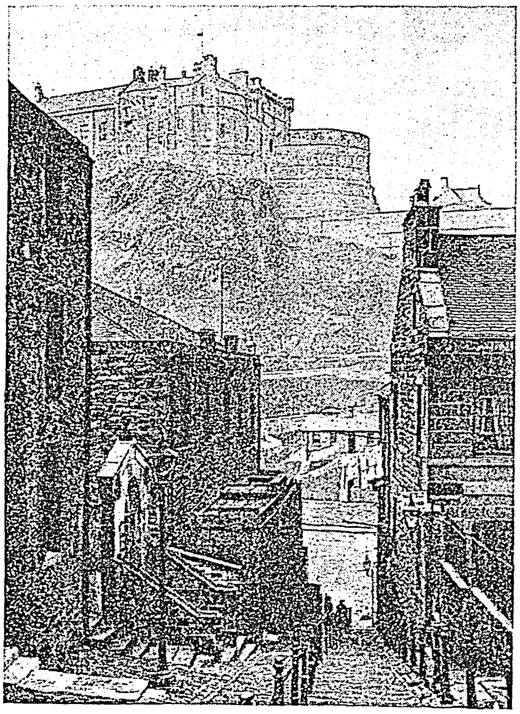


The street running across the middle of the picture, with a railway tunnel passing underneath it, follows along a high embankment called the Mound, which connects the two parts of the city. Fronting on the street are the National Gallery on the right, with the Waverley Station behind it, and the Royal Institute on the left. Behind the Institute is East Princes Street Gardens, with the Sir Walter Scott monument in the middle. Along the left-hand edge of the park runs Princes Street, the principal thoroughfare of Edinburgh. Behind the large hotel in the middle of the view rises Calton Hill.

who spent more of his time poring over old manuscripts in the famous Advocates' Library than in seeking clients or pleading their causes. To his memory has been erected what is perhaps the world's finest monument to literary genius. This stands in the East Princes Street Gardens and consists of a 200-foot Gothic spire of red sandstone in whose niches are statues of the famous characters in Scott's writings. Under this elaborate canopy is a fine marble statue of Sir Walter himself, with his favorite dog. A Carnegie library gives the city a touch familiar to Americans, and this Scotch-American millionaire gave largely also to the University.

Among the famous side-trips you will take when visiting this city are the ones to Abbotsford, Scott's castle-like home on its terrace above the Tweed; to Burns' little thatched cottage near Ayr; and the interesting but less romantic one to the remarkable bridge spanning the Firth of Forth near Edinburgh, a bridge which is one and a half miles long, cost more than the United States Capitol at Washington, and is one of Scotland's greatest engineering wonders.

EDINBURGH'S HISTORIC CASTLE



Here is one corner of the frowning pile which once was the home of the kings of Scotland. Portions of the building are now used as a museum and are open to the public.

Edinburgh, despite its nickname "Auld Reekie" ("old smoky"), is not much of a manufacturing center. Brewing, printing, and glass working are its chief industries. Like its sister city Glasgow, 47 miles to the west, it has a progressive municipal government.

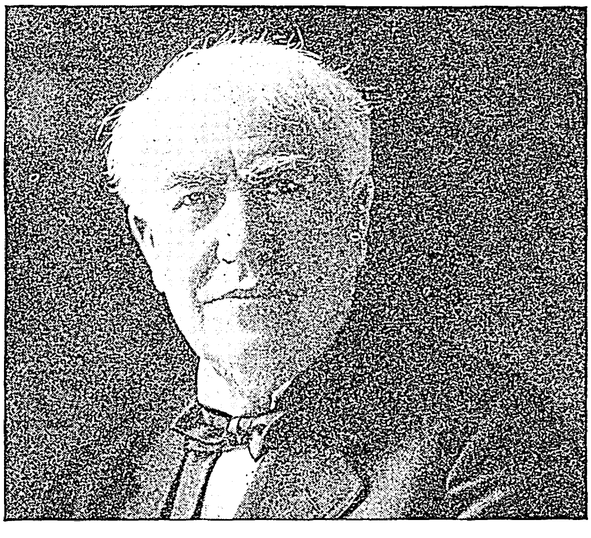
Edinburgh was settled before Roman times. In the 7th century, when the Angles of Northumbria seized it, it was named after their king "Edwin's burgh." Their occupation of the site was marked by the erection of the first fortress to occupy the "Castle Rock." In the 10th century the town was seized by the Scots, and from then on its history consists largely of struggles between Scots and English for its possession until 1437, when it became the Scottish capital. The English destroyed the town in 1544, but it was soon rebuilt. Population, about 440,000.

The MOST INGENIOUS *of* AMERICANS *and His Amazing Inventions*

A "born inventor" if ever there was one, Thomas Alva Edison was known as the "boy wonder of electricity" almost before he was old enough to vote. Often in early days he endangered his scant livelihood for the pure joy of working out his ideas. After he had found success and fortune, the irresistible interest of his work kept him at it for long untiring hours, often for days and nights together without sleep. It was said of him that "he kept the path to the Patent Office hot," for his patents in the United States alone number more than 1,000. No other man has done half so much to apply scientific discovery to everyday life. "There is not an electrical instrument or an electrical process now in use," it has been said, "but bears the mark of some great change wrought by this most ingenious of Americans." His life may well be an inspiration to any boy who wants to attain the success of honored, useful, happy manhood.

EDISON, THOMAS ALVA (1847–1931). The thing that impresses the reader of a life of Edison, first and last, is its joyousness. From babyhood he was the busiest, happiest, most interested boy in the village of Milan, Ohio, where he was born on Feb. 11, 1847. He was too busy to play much with other boys, to be sure; and at school, where he spent only three months of his life, he passed for a dunce. His wise mother, however, understood her sturdy little "sober-sides," and he gained the most valuable education possible through following the promptings of his unchecked curiosity. He was a great reader, devouring Gibbon's 'Decline and Fall of the Roman Empire' and Hume's 'History of England' at an early age. Indeed, when the family moved to Port Huron, Mich., he set to work to read all the books in the public library, but he had the good sense to stop before very long.

AMERICA'S WIZARD OF INVENTIONS



At ten years of age his favorite study was chemistry. One of his earliest experiments was to try to make a boy fly by giving him a huge dose of Seidlitz powders, expecting that the gases generated would make him light enough to float in the air!

To earn pocket money to stock his growing laboratory, Edison took a job at 12 as a train-boy. His two runs a day gave him plenty of time for chemical experiments, and all went well until one day a stick of phosphorus started a fire in the crude laboratory he had set up in the baggage car. The conductor threw the boy and his equipment out, and Edison's railroading days came to an end.

An accident at about this same time began the deafness which afflicted the rest of his life. But Edison refused to be downcast, and often said that deafness had been a blessing in disguise to him, because it had relieved him of many distractions.

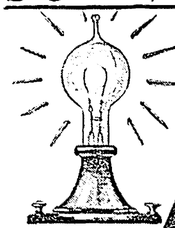
In saving the life of a station-agent's baby the lad won a friend who taught him the trade of telegraph operator. He soon became skilful in sending and taking messages, and at 15 he was in charge of an office. But he was determined to know how the instrument worked and why, and experimented with an old battery in his father's cellar until he understood it.

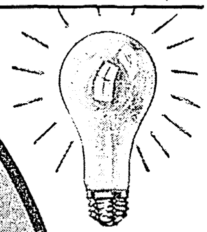
One of Edison's first inventions was a telegraph repeater, which automatically relayed a message to a second line. The second instrument was arranged to work at a slower rate than the first, so that he could copy down dispatches which came too fast for him to take. This device was the germ from which some of his later important inventions developed—notably the phonograph. But all it earned him at the time was a reprimand from the manager of the telegraph office.

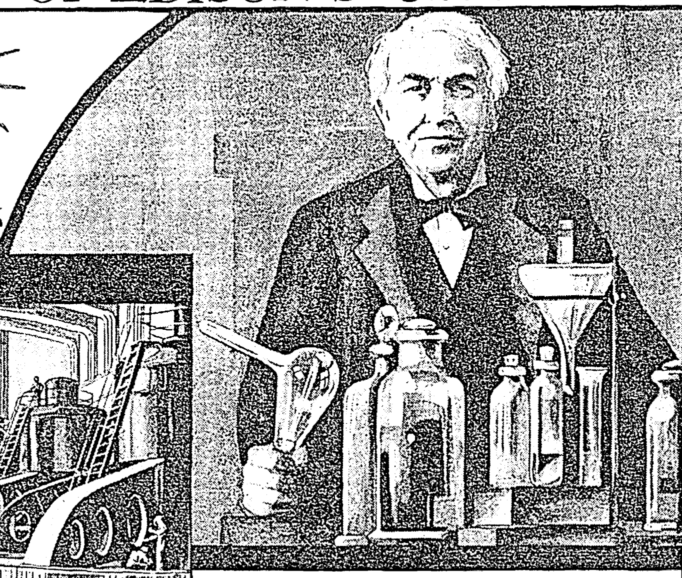
The young Edison dressed shabbily and spent all he earned on books and apparatus. He was thought to be an impractical dreamy young fellow, and his employers were often impatient. For five years he led a wandering life as a "tramp operator," often out of a job, but working hard on his ideas for inventions. His notion of fun was to be so absorbed that he didn't know if it were night or day. "I owe my success," he often said, "to the fact that I never had a clock in my workroom." He also said that "genius is 2 per cent *inspiration*, and 98 per cent *perspiration*."

At 21 Edison devised a "stock quotation" printing apparatus. For this and other inventions useful in

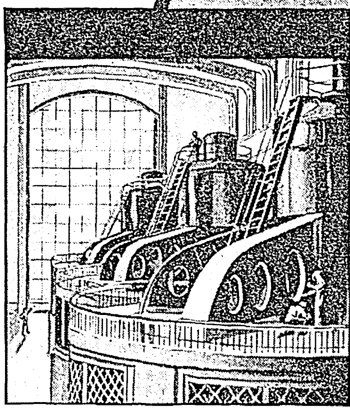
SOME OF EDISON'S GIFTS TO THE WORLD



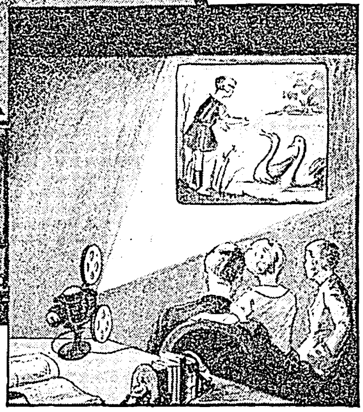




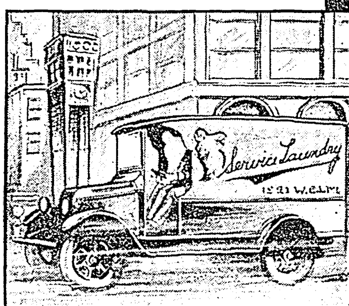
An incalculable burden of drudgery has been lifted from life, and the people of the world have been bound together with closer ties, by the genius and patient labor of Thomas Alva Edison, the electrical wizard of the modern age.



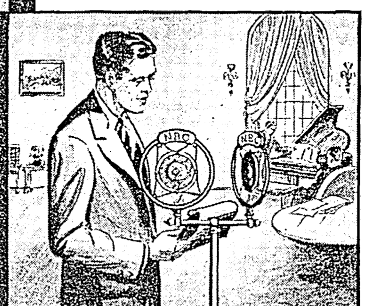
Edison so improved the dynamo that it became suitable as a generator for vast systems of distributing current to industry and to homes.



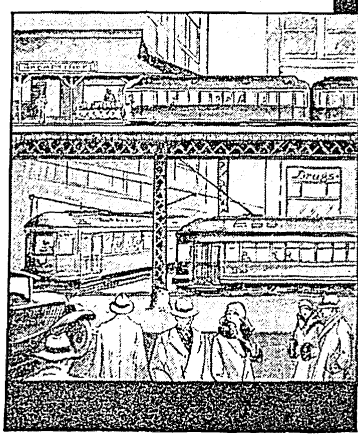
Edison's great invention, the motion picture, dances even in homes today. Radio broadcasters reach millions, thanks to Edison's microphone.

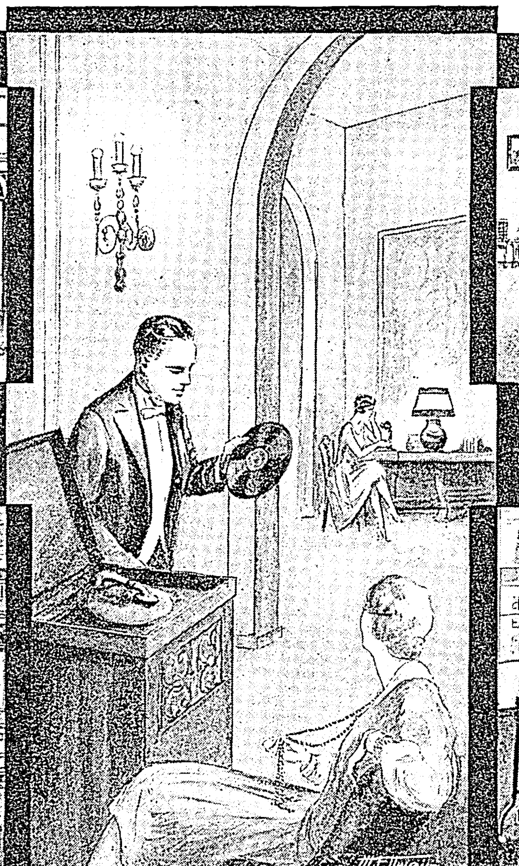


The Edison alkaline storage battery drives fleets of electric trucks. The electric railway also owes much to Edison's pioneer work.



The business man's stock ticker, his dictating machine, and the transmitter of his telephone are due wholly or in part to Edison.



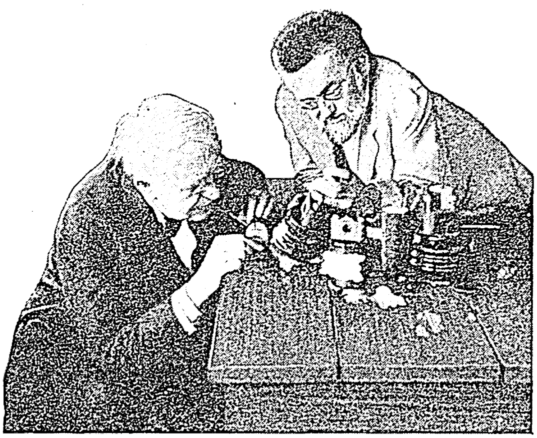


For light, music, and many electric devices, the modern home is indebted to Edison.

broker's offices he got $40,000. With this money the young genius started a laboratory and factory in Newark, N. J. It was the most remarkable establishment in the world, where the 300 employees worked from sheer enthusiasm. Here Edison coined his inventive brains into money. He had 50 inventions at various stages at one time. But before he was 30 his health failed, and he gave up his factory for a laboratory at Menlo Park, N. J., where he devoted his time entirely to invention.

A big workshop and a small house suited Edison exactly. He went about in shabby work-clothes and with acid-stained hands. Most of the time his wife and children dined alone, for the "Wizard" ate when he was hungry and rested when he was tired—working 18 and 19 hours a day as a rule—and had as much fun in his work as a boy at a ball game.

TWO WIZARDS OF ELECTRICITY



Edison is here examining the results of an experiment by Charles P. Steinmetz. Both these men were geniuses in devising new ways for the practical application of electricity.

Not all of his inventions were made easily. Some he worked on for years and spent thousands of dollars in perfecting. One rule he always kept: "Be sure a thing is needed or wanted, then go ahead."

On Oct. 21, 1879, Edison introduced the modern age of light. In his laboratory at Menlo Park, the young man tensely watched a charred cotton thread glow for 40 hours in an exhausted glass bulb. He knew then that he had invented the first commercially practical incandescent electric light, after spending $40,000 on experiments. But this was only the beginning. He must search the earth, at great expense, for a filament which would burn for many days. (*See* Electric Light and Power.) He had to improve the dynamo to furnish the necessary power, he had to develop a complete system of distributing the current, and he had to build a central power station.

Fifty years later, in October 1929, American leaders paid tribute to the great inventor on "Light's Golden Jubilee." Overseas came the voice of the German scientist Einstein. The speeches were borne to millions by radio. Cities were brilliantly lighted. A jubilee stamp was issued. The setting for the event was the "permanent birthplace of light," created by Henry Ford at Dearborn, Mich., near the Edison School of Technology. Here Ford moved the original Menlo Park laboratory and the very railroad station where the newsboy Edison was "dumped" after he set fire to a car with his chemicals.

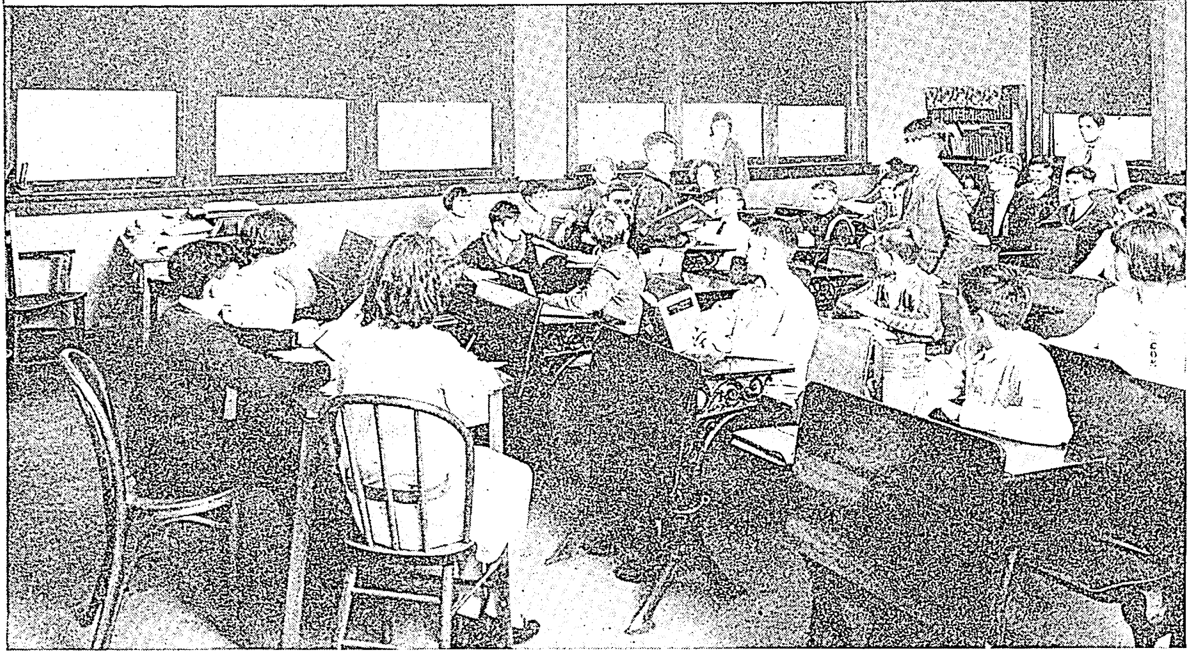
Edison outgrew his Menlo Park laboratory in 1886 and moved to an immense plant at Orange, N. J. His major inventions were the incandescent electric light, the phonograph, motion pictures, automatic and multiplex telegraphy, the carbon telephone transmitter, a stock ticker, the alkaline storage battery, and the microphone. He also helped transform modern life in scores of other ways. The great electrical expert, Charles Proteus Steinmetz, was quoted as saying that Edison had done more than any other man to promote electrical engineering. He improved methods of concentrating iron ore and made many improvements in the manufacture of portland cement. During the World War he concentrated on naval problems and the production of chemicals. After 1927, he experimented to produce rubber from plants and bushes grown in the United States. When his last illness kept him from his laboratory, he directed these experiments from his bed. Shortly before his death, his son, Charles, and other assistants brought him four samples of goldenrod rubber—the last fruits of his genius.

Edison died on Oct. 18, 1931, at the age of 84. He was buried at Orange, on the fifty-second anniversary of his invention of the incandescent globe. Honors had come to Edison until he could "count his medals by the quart," as he once jokingly said. He had degrees from many famous universities. Wealth poured in from his hundreds of valuable inventions. The great industries based on them—public utilities, the manufacture of electrical apparatus, motion pictures, and the like—yielded great fortunes for many people and produced billions of dollars in dividends, salaries, and wages.

One secret of Edison's success was his unlimited patience. Men who worked with him never saw him discouraged. His powerful imagination, his firm optimism, and his complete self-confidence also helped to distinguish him from ordinary men.

EDMONTON, ALBERTA. Edmonton has always been a crossroads of trade. Early in the 19th century, it was a fur outpost of the Hudson's Bay Company. Today, it is connected by the Canadian Pacific and Canadian National railways with east and west markets and with Alberta's wheat and cattle sections. Though still a fur center, it has more important industries, such as packing houses, flour and saw mills, and other manufacturing plants. Natural gas, water power, and coal are abundant. Edmonton's population increased from 2,000 in 1900 to 85,774 at the 1936 census. Situated on the deep-flowing Saskatchewan River, it is the capital of the province, and has the provincial university. It is a progressive city, owning and operating its street-car service, electric light, telephones, hospitals, and waterworks.

EDUCATION—Builder and Guardian of CIVILIZATION



The "socialized recitation" has transformed the modern classroom. Three leaders of the group sit at a table in the front of the room, while other members take part in the discussion. The teacher is merely observing and supervising.

EDUCATION. The word "education" means to most of us the work that goes on in schools and colleges. We generally think of an "uneducated" man as one who has not attended school—or who at least has not somewhere and somehow learned what is usually taught in school. We speak about varying degrees of education in terms of attendance at school. Thus we say that a person has a "college" education when he has been graduated from a college; a "high school" or "secondary" education when he has finished the work of a high school; and only an "elementary" or "grade school" or "common school" education when he has progressed no further than the seventh or eighth school year.

As the derivation of the word suggests (Latin *educere*, "to draw out"), it may be used, however, in a much broader sense, to mean the operation of all forces that act upon a person from without to influence the way in which he thinks and feels and behaves. We say "all forces that act upon a person *from without*," because one's thoughts and feelings and behavior are very often and sometimes very powerfully influenced by forces that act from within—by urges or dispositions or tendencies that one has inherited from one's parents in the same way that one has inherited blue eyes or brown eyes, blond hair or dark hair, a long straight nose or a short stubby nose.

This important difference is more clearly seen when we compare man with the lower animals. Generally speaking, the ways in which birds and fishes and mice behave are not taught to them by their parents. Most of the lower animals are born with tendencies or "instincts" that impel them to act in fairly definite patterns without instruction or training of any sort. Birds, for example, go through a complicated set of movements in building their nests; even if the young are taken away from their parents very early in life, and brought up in such a way that they never see other birds, the complicated movements that result in the building of a nest will begin when the proper time comes, and will be carried through to completion provided that suitable materials are at hand; and the finished nest will be similar to the nest that the parents and grandparents and great-grandparents built—provided again that the materials are similar. And so with the behavior of fishes. Eggs of the salmon are hatched in fresh water in the upper reaches of certain rivers. The young salmon, which never sees its parents, swims or is carried by the current to the sea, and here it grows to maturity in salt water. When the time comes for laying its eggs, it seeks the rivers and swims upstream, struggling against rapid currents and often leaping through the air to quieter water when the currents become too swift.

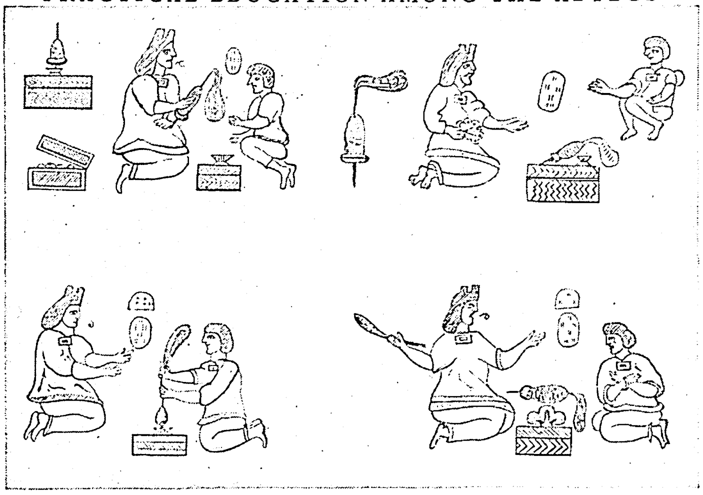
All this is "untaught" behavior and is provided for by the inherited tendencies, or "instincts," of which we know little except that they are inherited; they are not the results of learning (*see* Learning).

Why Man Needs Education

Most of man's behavior, on the other hand, is largely the result of the processes of education. Suppose an infant should be separated from his parents

very early in life and should grow up quite apart from other human beings. How closely will his behavior resemble that of his parents? He can use his vocal organs to make sounds, but no one has taught him a meaningful language. He does not cook food, for no one has taught him how to make fire; even though he lived to a ripe old age it is not likely that he would himself invent or stumble upon a way; even if he came across a fire started by lightning, he would not know how to use it for cooking. If he found somewhere a chest of carpenter's tools, it would probably take him years to discover their uses; and even then, any shelter that he might build would scarcely resemble the house in which he was born. If he chanced to fall into deep water he would almost certainly drown, for swimming is not instinctive with man—at least after a very early age—but is an activity that he must be taught.

PRACTICAL EDUCATION AMONG THE AZTECS



An old Aztec drawing, made before the Spanish conquest, shows a mother teaching her daughter how to spin. In the first picture she hands the child the distaff, with the promise of a cake or cooky, visualized above the girl's head. In picture 2 the girl is trying to beg off, and the mother is stern. The girl returns to work on the promise of an additional half of a cooky, and the fourth scene shows the mother pointing to the "pantry."

Does man, however, have no instinctive or inborn tendencies similar to those of the lower animals? Although students of the problem disagree on this point, most would answer, yes. Certain it is that such a person as we have just imagined, feeling the pangs of hunger, would instinctively seek for food; but he would not in all probability instinctively seek the right kinds of food. So, in order to permit him in our imaginations to grow to maturity, we shall have to provide some miraculous way of getting him fed and sheltered! If he were attacked by animals he would doubtless either fight or flee. Probably he would also feel an instinctive urge to pry into things, to take things apart, and to put things together.

Thus, man seems to differ from the lower animals in having far fewer instinctive tendencies that result in definite patterns of behavior. His inborn tendencies are more in the nature of urges to act rather than to make, without being taught, definite and organized movements such as those that the bird makes in building its nest. What man *feels* is influenced strongly by inherited tendencies; what man *does*, or the precise way in which his feelings work over into action, depends largely upon what he has been taught—in other words, upon his education.

It will be noted that we are now using the word "education" in a much broader sense than that which implies merely the teachings and learnings that take place in school and college; nevertheless it is with teachings and learnings that education is always concerned. Man differs from the lower animals not in the fact that he can be taught, for many of the lower animals, such as the dog, the horse, and the elephant, can be taught to make complicated movements and to respond to commands; but man differs radically from the lower animals in that he *must* be taught if he is to live successfully in the world into which he is born—that is, the world of men and women, the social world. In its broader meaning, education is a prime condition of human or social life.

Education and the Social Heritage

We have said that certain tendencies or urges are inherited. This kind of inheritance is spoken of as physical. The "physical" heritage may be contrasted with the "social" heritage. The former consists of those things that we have in virtue of being born of our parents: our bodily organs and many of their characteristics; the instinctive urges already referred to; and in some degree our mental alertness or the lack of it, our brightness or dullness, our ability or inability to learn quickly. Our social heritage consists of what we get from our education, again using the word in its broader sense. The language learned in early childhood is a most important part of our social heritage. The "mother tongue" of an English boy brought up from infancy by Chinese foster-parents would not be English but Chinese. Since our manner of eating and the kind of clothing we wear fall under our social heritage, this boy would eat with chop-sticks and wear the flowing garments of the Orient. Our religion is a part of our social heritage, and so our English lad would be, in all probability, not a Christian but a Confucian. What is sometimes called our cultural background is an important part of our social heritage; and this boy, reared in a Chinese home and sent to Chinese schools, would have in manhood the Chinese attitude toward life, rather than that of the Englishman. Though he would not have the saffron skin, the almond eyes, and the coarse straight hair of most Chinese people, his standards of conduct, his tastes in music and literature, and his ways of thinking would be Chinese. In many respects, then, one's

social heritage is vastly more important than one's physical heritage, for it determines the degree of culture that a person, a race, or a nation may attain.

The fact that varying degrees of literacy (the ability to read) are today among the most important causes of differences among nations is in itself an evidence of the outstanding significance of social heredity as compared with physical heredity. It also explains why we usually associate the word "education" with books and the work done in schools.

Invention of Writing

Language is the chief medium of social heredity, for it is through language that most of the lessons learned by past generations have been handed down to the new. Before the invention of writing, which has been characterized as the greatest single event in the history of mankind, these lessons were handed down, by example (teaching) or by imitation (learning). Handicrafts were learned by observation. Traditions and folk-tales were perpetuated by word of mouth.

With the invention of writing there became available a much more accurate and dependable means of preserving the lessons learned from race experience. A simple test has shown the importance of written records. A teacher of history in a class of 30 pupils writes a simple statement on a piece of paper. He reads the statement to one pupil who has been asked to step outside the room. The teacher then returns to the room and asks a second pupil to go out and receive the message from the first. The first pupil returns to the room and a third receives the statement from the second. One by one the members of the class receive the message in this manner. When the last pupil returns, he is asked to give the message to the class. The original message is then read. It is astonishing how little the final version resembles the original; in most cases, indeed, no resemblance whatsoever remains after the statement has been passed by word of mouth through 25 or 30 different people. This experiment will convince even a child that the passing on by speech alone of what mankind has learned must have caused serious mistakes and misunderstandings. Writing in large measure prevented such errors and made possible the gradual accumulation of increasingly accurate knowledge. (*See* Writing.)

Written records had great advantages over oral or word-of-mouth transmission, but they, too, had important limitations at first. It was costly to prepare them, especially if a number of copies was desired. Very early they were used to record important business transactions, such as the sale of land. Not infrequently rich and powerful rulers were glad to have their achievements, especially in warfare, put down in writing so that future generations might know about them. Some of these rulers also had the old traditions similarly preserved. In general, however, writing and reading were arts which only a few people managed to master.

Notwithstanding these limitations, writing played an important part in many of the ancient civilizations —in Egypt and Assyria, and especially in Greece and Rome; and from the writings that have been preserved —governmental records, laws, business records, personal letters and diaries, and manuscript books—it has been possible so to reconstruct the history of these countries as to give us a fairly accurate notion of what their civilizations were like. We know something, it is true, of civilizations that developed before the invention of writing. This knowledge has been gained from a study of such remains as buildings, implements, utensils, and weapons; but our knowledge of these "prehistoric" peoples is far less extensive and accurate than is our knowledge of the ancient peoples that left written records. (*See* Archeology; Civilization.)

Contribution of the Printing Press

A most important turning point in the history of civilization came with the development of the printing press in Western Europe. This development began about the middle of the 15th century—the same century that witnessed in its later decades the opening of the golden age of discovery and exploration with which are associated the names of Prince Henry the Navigator, Columbus, the Cabots, and Vasco da Gama. In fact, the printing press and the era of discovery and exploration went hand in hand as the precursors of modern civilization.

Printing made possible a much wider spread of knowledge than the art of writing alone permitted. Where books had formerly been laboriously copied letter by letter, sentence by sentence, page by page, there could now be produced, by the simple turning of a lever, four, eight, even twelve pages at a time. Books gave to the early explorers many facts that they could not have known had the spread of knowledge still been limited to hand-written documents. Books likewise made the results of discovery and exploration known to people all over Western Europe, forming the yeast of a vast ferment which was destined to change the course of history and to bring about a new type of civilization. (*See* Books and Bookmaking; Printing.)

It is small wonder, then, that the term "education" is so closely associated with books and schools, and that literacy plays such an important part in the civilization of today.

Early Forms of Education

It must not be forgotten, however, that education in its broader sense includes much more than the formal instruction given by the schools; it includes, as we have seen, all of the forces that operate upon man from without to determine the ways in which he thinks and feels and acts.

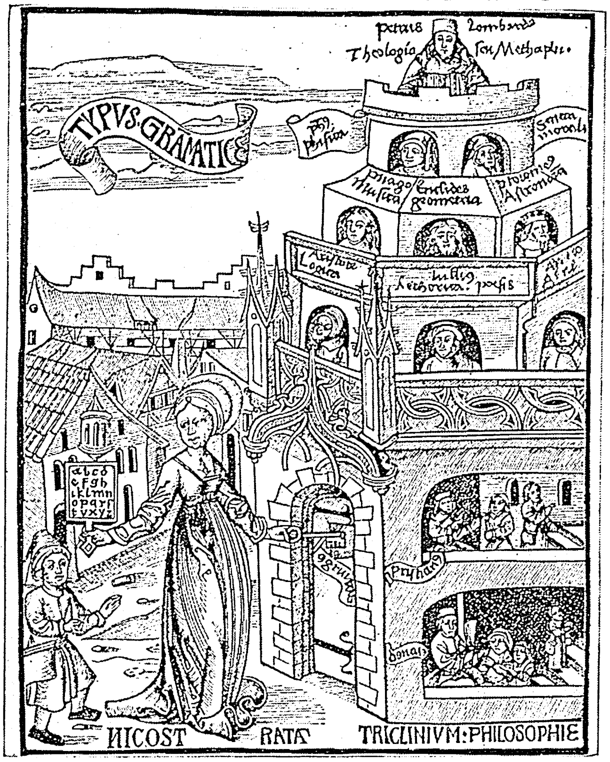
Of the beginnings of education and the consequent beginnings of that accumulation of human experience which we have called the social heritage we have no certain knowledge. It seems likely that primitive man learned his first lessons from the natural forces that operated around and about him. His teachers were plants and animals, cold and heat, rain and snow, the storm and the drouth and the lightning, mountain, swamp, plain, and forest. He found that some plants

were good food and that others made him ill and that still others caused death. Some animals, he learned, could easily be killed, and these furnished him with good food; others were to be avoided. There is every reason to believe that it took him a very long time to learn how to make and use even so crude a weapon as a stone ax or so simple an implement as a bone needle. When and how he first made fire his servant is shrouded in mystery; and whether he first used fire to cook his food or to keep himself warm or to frighten off beasts of prey is likewise unknown. It is known, however, that man could make fire and cook his food many thousands of years before he learned how fire may be used to smelt ores into metals. (*See* Fire.)

These and many other arts and devices were kept alive and improved by teaching them to the young of each succeeding generation. Natural forces were man's first teachers but these were soon supplemented by human teachers—fathers and mothers, grandparents, older brothers and sisters, and the priests and leaders of the tribe.

The lessons passed on thus from generation to generation took three forms. In the first place, there were the ways of doing things—such as fashioning crude weapons and utensils, building shelters, making clothing from the skins of animals, hunting, fishing, and fighting. In the second place, there were the "traditions," the rude beginnings of what we now call organized knowledge or science. At first and for long centuries this was merely a collection of statements which were thought to be true but which were often the result of incomplete or faulty observation of the facts, or which gave (because of the limitations of oral transmission) an increasingly distorted picture of the original observations. In the third place, there were the religious beliefs and superstitions—the childlike attempts to explain the nature of the world and of man, and especially to give man some ray of hope in the face of the tragedy of death (*see* Magic).

THE STEEP CLIMB UP THE ROAD TO LEARNING



This allegorical picture of the progress of education appears in Gregor de Reisch's 'Margarita Philosophica', 1508. When the youth has mastered the horn book, Wisdom unlocks the temple, and he enters, to study the *Trivium*, including Grammar, Logic, and Rhetoric, then passes to the fourth floor to the studies of the *Quadrivium*, and on up to the pinnacle, Theology.

Curriculum of Primitive Culture

These arts, skills, traditions, and beliefs formed the "curriculum" in the education of primitive man. The father saw to it that his sons learned how to hunt and fish and fight; the mother trained her daughters in such domestic arts and skills as were known to the group of which she was a member. Traditions and beliefs were learned from the elders, from the leaders, and from the priests.

It is probable that man has always been a social being; he has lived by coöperation with others of his kind rather than by fighting his way through life alone. From the outset the clan or tribe has probably played an important part in the education of the young. It certainly plays an important rôle among the primitive peoples living today. In large part their education is informal. The children learn the arts and skills by imitating what their elders do, and they become familiar with the traditions and beliefs by listening as these are recounted in the home or around the camp fire.

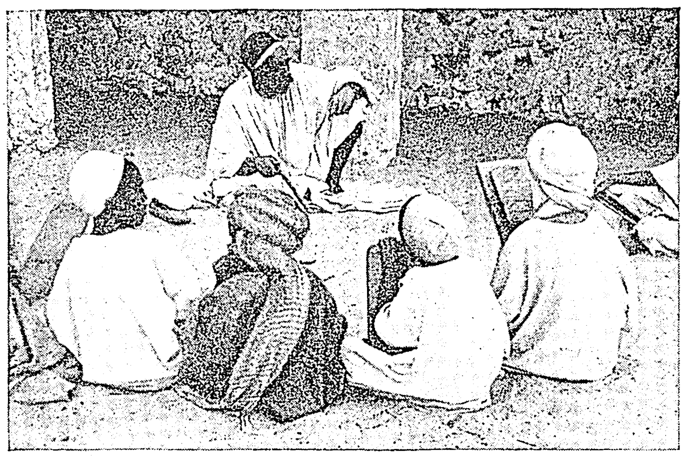
Many savage groups, however, have what might almost be called schools. When the boys and girls have passed the age of childhood and are ready to enter upon the duties and responsibilities of adult life, they are required to go through a series of formal initiation ceremonies to test their ability to take a responsible part in the life of the tribe and to impress upon them the importance of loyalty to the tribe's standards and beliefs. Sometimes these ceremonies are very elaborate and prolonged. Such ceremonies are found so generally among the primitive peoples living today that we must assume that they existed very early in the history of mankind and that they formed the beginnings of that type of organized formal education which modern civilization has developed so elaborately in its schools and colleges and which ancient civilizations possessing a written language developed thousands of years ago on a much less extensive scale.

Education in the Ancient World

From this point on we shall be concerned chiefly with what we have called formal organized education, that type which is associated with the classroom. It must be borne in mind that the informal types of

education still persisted. Even today some of the most important lessons are learned in the home, on the playground, during apprenticeship, and in one's religious experiences. Moreover, informal types of education grew and expanded as mankind passed from savagery to the more complex forms of social life. Long before the beginnings of recorded history different peoples in different parts of the world had ceased to depend upon hunting and fishing for their food. Some came to live largely upon the meat and milk of animals that had been domesticated, and to depend for clothing upon hides, hair, or wool. In order to obtain food for these animals, they drove them from one pasture to another, often over wide areas of desert land. These were the nomadic tribes. Other peoples learned how to domesticate plants as well as animals and became farming peoples with a settled mode of life. In both instances, a substantial advance was made from the stage of savagery, and the new arts of plant breeding and cultivation and animal breeding and care were highly important additions to the social heritage. Like other contributions, they could be preserved only by educating the young of each generation.

DRONING THE VERSES OF THE KORAN



In this village in the heart of the Sahara, where life is simple and the law of the Prophet unquestioned, problems of lighting, heating, and curriculum vanish. Pupils squat on the sand and memorize each day a bit of the Koran written on the boards they use for slates.

Specialization of Work

New discoveries and inventions also led to new kinds of informal education by increasing the variety of occupations in which people engaged. Among the savages practically all of the men did the same kinds of work—hunting, fishing, fighting—and practically all of the women did the rest of the work. When man learned how to make weapons, tools, implements, and ornaments from such metals and alloys as iron and bronze, the skills became too complicated to be taught to everyone and a special group was set aside to make these articles for the rest of the tribe. As other discoveries and inventions were made, a similar need arose for highly skilled workers who would give all of their time to the practise of their specialized arts or trades. From time to time new workers were added to such groups, and each new worker was of necessity subjected to a prolonged training under a master workman. In this way a new type of education developed known today as the apprenticeship system (*see* Gilds). Until recently all recruits for the skilled trades were trained under this system, and even today the teaching of trades in schools by the methods of formal education has not displaced the informal education of the apprentice. Some authorities maintain, indeed, that the teaching of the skilled trades in schools is much less effective than trade training "on the job."

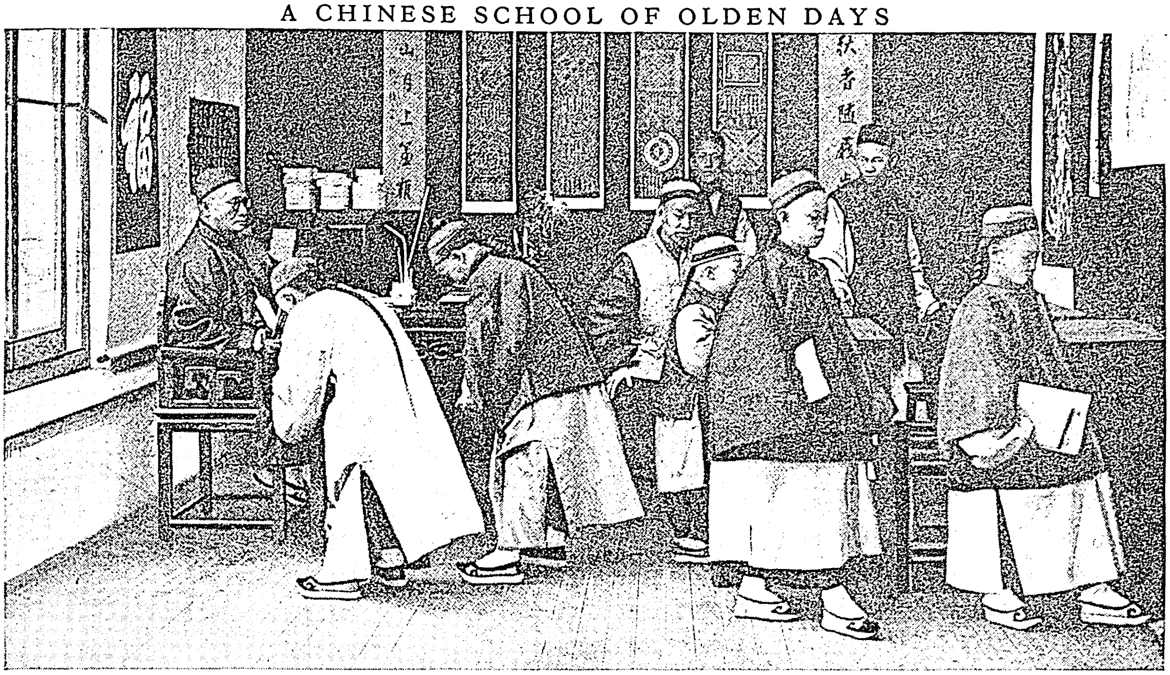
The developments just discussed, it will be remembered, had their beginnings among prehistoric peoples and have continued in one form or another to the present day. In the meantime, beginning with the peoples of antiquity who practised the art of writing, the types of formal education developed have become increasingly important.

In nearly all of the nations of the ancient world, education based upon a knowledge of reading and writing was limited to a very few. The great masses of the people received only training in the occupations that they were to follow, and informal instruction by word of mouth in the traditions and beliefs of the national group to which they belonged. Two of the ancient civilizations have persisted with little change over thousands of years—the civilizations of India and China. A brief reference to the more formal types of education that have prevailed in these two countries will give a fair idea of the educational conditions throughout the ancient world up to the time of Greece and Rome.

Education in India

In India today scarcely one adult out of thirty can read and write. There, as in nearly all of the nations of antiquity, a rigid caste system has prevailed. At the top are the Brahmans, a group which includes the priests and those who have been trained for the other learned professions—law, medicine, and teaching. Below the Brahmans are the military leaders and those engaged in government. Next are the skilled craftsmen and the tradesmen. Still further down the scale are those who do the menial and unskilled work. Finally there are the outcastes—the "untouchables." Sharp lines separate these groups. One is born into one's caste; one cannot rise to a higher, but one may by misconduct sink to a lower—that is, "lose caste." For centuries, the privilege of learning to read and write was limited to the three upper classes—in actual practise almost exclusively to the Brahmans. In recent times, the efforts of the British government and of Christian missionaries have modified to some extent these rigid limitations. In a few Indian provinces, indeed, fairly extensive systems of modern education have been organized and are now in operation. As in all of the other oriental nations, the work of the

A CHINESE SCHOOL OF OLDEN DAYS



Great was the ceremony in the Chinese school of the old days. The young pupils, in old-style "pigtails," made the schoolmaster a dignified bow before leaving for home each day. Nowhere has learning been respected more deeply than in China, and nowhere, seemingly, has it accomplished less, for, until recent years, it included nothing but stale memorizing of the classics. Even today, with Western ideas revolutionizing the schools, the difficult Chinese writing hampers public education.

Indian schools has been very largely a verbatim memorization of sacred books. The four books of Veda, the six books of Angus, and the Code of Manu have for centuries constituted the curriculum. In the books of Veda and Angus the Hindu traditions and beliefs are set forth; the Code of Manu is a compilation of customs and standards for the guidance of life.

Education in China

Formal education in China followed a similar course for centuries, except that the class system was far less rigid. The person who could read and write and who had mastered the writings of Confucius was eligible to take a series of severely competitive governmental examinations. If he succeeded in these, his future was assured, for now he belonged to the highest social class. The important governmental posts were filled by appointments from this group. No country, ancient or modern, has placed a higher premium upon formal education than did China from very early times to within the past few decades. In no other country has the calling of the teacher been so highly respected.

The only people of antiquity who attempted to teach everyone to read were the Jews. About 500 B.C. their first schools were opened, but these were for the few who were to be religious leaders. Between 200 B.C. and 100 B.C., parents were required to teach their children to read; and although it is improbable that modern standards of universal education were approached, it is likely that, as a national group, the Jews were by far the most literate ancient people.

The development of the art of writing, as we have seen, was an important advance over the transmission of the heritage of tradition and belief by word of mouth. At the same time, it involved some serious disadvantages. As traditions and beliefs became crystallized in written form they tended to become fixed and not readily changeable—especially when, as in most of the nations of antiquity, the writings were looked upon as sacred. This tendency was furthered by the emphasis upon verbatim memorization of the sacred writings, the usual method of learning in the ancient schools. Savage peoples live very largely in the present; the ancient civilizations, in a quite real sense, lived largely in the past. Both India and China illustrate the latter tendency.

The Schools of Greece and Rome

The signal contribution of the Greeks to civilization and to education lay in the fact that after they recognized the dangers of this formal and rigid worship of the past, they set up a new ideal of progress. Unlike other ancient civilizations, the tendency of Greek civilization was toward the future. This ideal has had a profound influence upon the development of education in modern times.

The change among the Greeks themselves came only gradually. For many centuries Greek education followed in general the pattern that prevailed in other nations of the time. There were, however, some unique characteristics of the older Greek education that are worthy of attention.

Training of the Spartan Youth

Perhaps the most interesting of the early formal systems arose in Sparta, one of the small independent states of the Greek peninsula. Heretofore we have

spoken of formal organized education as if it were largely concerned with books. Spartan education was highly organized, but it had little to do with reading and writing. The Spartans had early conquered neighboring tribes. These tribes did not become citizens of Sparta but were held in subjugation as captive peoples. The Spartans, as a ruling class, found military prowess and skill in warfare their most important needs. Their educational system was designed to meet these needs. Its aim was to develop strength, courage, cunning, endurance, and an unswerving loyalty to the state.

The state, indeed, had supreme power over the individual from birth onward. Infants who appeared to be weak or sickly were ruthlessly left to die. Those who were strong and healthy remained with their mothers until the age of seven. Then the boys were taken to the military barracks where they went through a course of training and discipline, the rigor of which has probably never been surpassed in the history of education. They were given only the plainest of food and often they were forced to test their endurance by periods of fasting. They were taught to endure extreme cold; they slept on hard beds with little covering; they went barefoot even in the severest weather; at regular intervals they were flogged to accustom them to bear pain without shrinking. Their physical exercises were carefully graded and again were designed to develop not only strength and alertness but also courage and endurance. At the age of 18, the boys began to receive explicit training in the technique of warfare, but the severe tests still continued—including the floggings.

Education in the national traditions and ideals was by no means neglected, but it was largely informal. The education of the girls, like that of the boys, aimed at producing physical strength, moral courage, and endurance. The girls, however, remained with their mothers until the time of their marriage.

Athens Stresses Mental Development

It was in another of the small Greek states—Attica, of which Athens was the chief city—that new ideals of education were developed. For a long time Athenian education resembled that of Sparta in the emphasis given to physical training, but state control of education was not nearly so marked, nor was the training of the young directed so exclusively toward fitting the individual for the service of the state. In other words, the needs of the individual were recognized much more clearly here than in Sparta—and in all probability, much more clearly than in any other civilization up to that time.

Then, too, a heavier emphasis was laid upon the education of the mind as contrasted with the training of the body. Reading and writing were taught to the sons of the Athenian citizens. As in other nations of antiquity, the alphabet was usually taught by tracing the letters in sand. After some measure of skill had been gained in this way, poems and other literary writings were copied on wax tablets with the stylus—a sharp-pointed iron pencil, the precursor of all of the pencils in the world today. Finally, when they were sufficiently skilful, the boys were permitted to write with pen and ink upon parchment or sheepskin.

The study of music formed a most important part of Athenian education—so vital a part that the first school attended by an Athenian boy was known as a music school, although it was in this school that reading and writing also were taught. Many of the great poems had been crystallized in the form of songs. The teacher not only taught the boys to sing these songs, but also explained the meaning of the words—a very great advance over the mechanical rote learning that prevailed generally in the ancient world. Learning to play such musical instruments as the flute and the lyre was also an important part of the Athenian curriculum.

The formal education of the typical Athenian youth extended over the eight years between the ages of 7 and 15. After this there were two years in which he learned a great deal through informal contacts with the life around him. At the age of 18 the boy began his two-year course of military training.

The Greek Slave-Pedagogues

The educational program just described affected only a small part of the population. The civilization of Athens, like that of Sparta, rested upon slavery. Some favored slaves, called "pedagogues," were appointed to accompany their masters' sons to school and to supervise their conduct. Probably some of these were captives who had had some formal education and were in consequence able to serve in a way as teachers of their young charges. Our term "pedagogue" as equivalent to "teacher" had its origin with the slave-pedagogues of the ancient Greeks. For the most part, however, the slaves and the common people, who made up the masses of the Athenian population, did not have formal schooling.

Early in the 5th century B.C., a series of events brought about fundamental changes in Greek life. The wars with Persia, extending over a period of 13 years, acquainted the Athenians with a civilization that differed in many ways from their own and thus broadened their outlook and expanded their range of knowledge (*see* Persian Wars). With the ending of these wars, Athens became increasingly important as a center of commerce and as a center of art and learning. Her ships traded with all of the Mediterranean ports; visitors from other countries crowded her streets. There were remarkable developments in poetry and the drama, and in the construction of beautiful buildings and their adornment with paintings and statuary. This remarkable growth in civilization culminated in the Age of Pericles, a period of 30 years (460–430 B.C.) during which the government of Athens was dominated by Pericles—one of the most brilliant statesmen in the world's history.

The Brilliant Age of Pericles

Perhaps it is not too much to say that the Age of Pericles was the happiest as well as the most brilliant era in the history of the world. All classes of free

THE EDUCATION OF THE YOUNG ALCIBIADES BY SOCRATES

Socrates taught by the "Socratic method," that of a conversation between teacher and pupil, a series of questions and answers which led the learner to an intelligent conclusion. The teaching of Socrates always emphasized the duty of the citizen to the state. The imaginative picture above shows Socrates instructing Alcibiades, surrounded by members of his wealthy household. The great philosopher's moral teachings seem to have made little impression on the youth, for he became dissolute and corrupt.

people were prosperous; justice was highly developed; the trading vessels brought comforts and luxuries from every known land. Even slaves—although their lot was doubtless hard enough—were treated far better than elsewhere. (*See* Pericles.)

There can be little doubt that the careful attention given by the Athenians to the education of youth was in part responsible for this remarkable civilization. This education as we have seen was well balanced. On the physical side, it provided for health and strength and grace. On the mental side it gave a substantial background of knowledge and an acquaintance with the best in literature and art. On the spiritual side there was a most effective discipline in the virtues of courage, forebearance, and consideration for others, and in the duties that each individual owed to his family and to the state. Spartan education made the individual entirely subordinate to the state; Athenian education in the Age of Pericles still held fast to the virtues of service and sacrifice, but it also recognized the importance of the individual and the necessity of a liberal measure of disciplined freedom as the basis of true progress.

All periods of prosperity have their dangers, and the Age of Pericles was no exception to the rule. Comfort and luxury tended to soften the moral fiber. Men began to think of their own pleasure and advancement rather than the progress of the social group as a whole. This change affected education in several ways. Physical exercises became less strenuous and were designed to promote individual grace and beauty rather than to develop the strength essential to the preservation of the state. The study of the classics was partly replaced by discussion with the writings of the times. Rigorous mastery gave way to less exacting methods of learning. The teacher's interpretations of the text were replaced in large part by informal discussions between teacher and pupils.

The Rise of the Sophists

The new ideals influenced to some extent the education of the younger boys, but they affected most profoundly the education of adolescents and young men. A demand arose for a type of instruction that would yield practical results in the way of individual advancement, and since such advancement for the governing classes meant success in political life, heavy emphasis was laid upon the arts of public speaking, debate, and argumentation. A group of private teachers grew up to meet this need. These teachers were known as "sophists." Some of them gave sound and honest instruction; others openly offered to teach almost anything that the student desired. Training in argumentation came to have as its primary aim the ability to secure an advantage over an adversary rather than to seek truth and justice; whence the term "sophistry" for a plausible but misleading statement.

These developments did not go on, one may be sure, without protests. Some saw nothing good in the swing toward individualism; some deplored the new conditions but believed that a return to the old was impossible; others were convinced that both the old and the new had virtues that should in some way be preserved.

Socrates, Plato, and Aristotle

Among the last named group was one of the greatest teachers and philosophers the world has ever known—Socrates. It was the belief of Socrates that the troublesome problems of his time could be solved by ridding the mind of error. He introduced a new method of teaching to attain this end. This general procedure is called the Socratic method, or the dialectic or con-

versational method. The learner is encouraged to state as definitely as possible a belief or an opinion. Then the teacher through a series of adroit questions leads him to see for himself wherein this belief or opinion is false or misleading. In his teachings Socrates concerned himself with moral questions: What acts are just? What unjust? When is a man brave? When cowardly? What constitutes a good statesman? His effort throughout was to bring the learner to the conviction that the conduct of the individual must be in harmony with the good of society or the state. (*See* Socrates.)

Socrates' teachings have been preserved for us in a series of dialogues and treatises written by his famous pupil Plato. Plato was himself a great teacher; he founded a school and developed still further the philosophy of education.

AN ENGLISH "DAME" SCHOOL

Although the spread of the Three R's was no doubt furthered by the "dame" school, conducted by some none-too-learned woman in her home, the sketch above, made from life in a London school, indicates the sordid and dismal nature of the public instruction meted out to children in England a century or so ago.

Plato passed on the torch to his pupil, Aristotle, who is perhaps the towering intellect of all ages. He is recognized as the father of natural science in that he based his conclusions upon very careful and extended observations. King Philip of Macedon appointed him tutor to his son, destined to be known in history as Alexander the Great; and Alexander's soldiers in conquering and subduing a large part of the then known world were under orders to collect and bring back to Aristotle specimens of the plants and animals which they found. Aristotle's writings on botany and zoölogy have been lost, but he applied the method of science to the study of moral conduct and politics, and his books on these and other subjects have deeply influenced human thought. In his treatise on politics or government he discusses the problem of education. (*See* Aristotle; Plato.)

Influence of Greek Thought

Neither Plato's nor Aristotle's scheme of education greatly affected in a significant way the actual practise of education in Greece, although their teachings powerfully influenced the subsequent development of civilization and education. Athenian education continued to be dominated by the spirit and methods of the sophists, and while Greece still led the world in art and learning, the glories of the Age of Pericles had passed, never to return. With the conquest of Greece by Macedon and the wide extension of the Macedonian Empire, Greek civilization and Greek education came to dominate Egypt and a large section of Asia Minor. Alexandria rivaled Athens as a center of learning, and later, after the beginning of the Christian era, far surpassed her. In the meantime, the conquering Romans had pushed their conquests into Greece and Egypt. This, however, did not destroy Greek culture and Greek education, and for a long time the universities both at Athens and at Alexandria attracted students from all parts of the known world. Even the patrician families of Rome often sent their sons to one of these universities.

Rome itself made important contributions to educational progress, but these were in the direction of a better organization of schools rather than the improvement of teaching or of programs of study. In the early days of the Republic, education was probably entirely of the informal type dominated by ideals similar to those that prevailed in Sparta, although far less rigorous. Later, with the development of the empire, schools were organized on the Greek pattern except that the work was far more formal. Rote learning prevailed and corporal punishment was apparently a common practise. Nevertheless schools were provided throughout the empire and although education was far from universal, it was generally available to those who could afford it.

Education During the Middle Ages

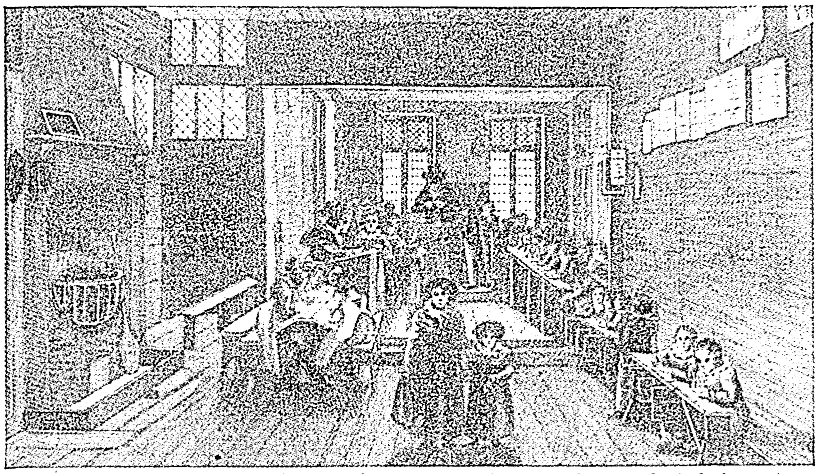
With the decline of the Roman empire in the 5th and 6th centuries A.D., formal education gradually deteriorated and almost disappeared. Justinian closed the schools at Athens in 529 A.D. During the five centuries that followed, the lamp of learning was all but extinguished in Western Europe. Christianity was now the prevailing religion, and in some monasteries of the Christian church the young monks were taught to read and write. In a few of the monasteries, especially those of the Benedictine order, monks spent part of their time in copying manuscripts—these had to do chiefly with church matters, but occasionally they copied a manuscript of some classical work. (*See* Monks and Monasticism.) During the darkest years of this long period, however, such monasteries were exceptional and most of the population of Western Christendom was steeped in ignorance. There were, however, always sheltered areas in which learning was kept alive. When the great emperor Charlemagne turned to the encouragement of learning he was able to find scholars in monasteries of Italy, England, and northern Spain to aid in the work (*see* Charlemagne).

Older Cultures Influence the Arabs

In sharp contrast to the Christian world during these fateful centuries were some of the new Moham-

medan nations. The Arab tribes that first embraced the Mohammedan religion had not advanced beyond the stage of barbarism. It is unlikely that Mohammed himself could either read or write. As his followers spread their religion through conquest, however, the people of northern Africa and Asia Minor, who for centuries had been under the influence of the Greek and Roman civilizations, became converted to the Moslem faith and in many cases adopted the Arabic language. The Arabs in their turn acquired in some measure the culture of the older civilizations, and their successive capitals—Damascus, Bagdad, Cairo, and Cordova—became centers of art and learning comparable in many ways to the Athens and the Alexandria of an earlier day. (*See* Arabia and the Arabs; Mohammed and Mohammedanism.)

EDUCATION UNDER THE WING OF THE CHURCH



When the ideal of general public education was new, churches often conducted elementary schools. Above we see a "charity school" in a room adjoining a dissenting meeting-house in London. The school was begun in 1687, but the picture was made in 1822.

Arab Contributions to Later Times

Probably the greatest service of the Arabs was to keep alive some of the priceless contributions of the Greek writers, especially those of Aristotle; but the Arabs made significant contributions on their own part. The chief of these, undoubtedly, was their adaptation of the Hindu number system and its introduction to the Western World. Gradually this system replaced the Roman notation, although the Roman numerals were, and still are, used for certain purposes. The development of the Hindu-Arabic system of notation is regarded by some authorities as a forward step as important in many respects as was the development of the phonetic alphabet. (*See* Arithmetic; Numerals.)

Arabic scholars, under the influence of Aristotle's writings, also made notable investigations in mathematics, medicine, and the natural sciences. They accepted the Greek theory that the earth is a sphere, and they computed with remarkable accuracy the length of a degree of longitude. In medicine, one of their treatises was the standard work for more than 500 years. Through their conquests, the Arabs became acquainted with many different peoples and with many parts of Europe and Asia to which the Romans had not penetrated, and their writings on geography were by far the best that had appeared up to that time. Their contributions to literature are represented by such books as 'The Arabian Nights', and their achievements in art and architecture by the splendid buildings and adornments that travelers still admire in southern Spain and northern Africa.

In Spain and Sicily Mohammedan civilization reached a high standard, and from these regions came the first of the influences that were to revive learning in Christian Europe. The century from 900 to 1000 A.D. seems to have been one of the darkest periods in the history of Western Europe, but by the turn of the millennium there were evidences that the worst was over. A few prominent scholars brought the learning of these Mohammedans into the Christian schools, notably at Salerno in southern Italy, which during the 11th and 12th centuries was the leading center for the study of medicine. Latin scholars also came into contact with scholars of Constantinople, where the ancient learning had never died out. The finest fruit of this contact was the revival of the study of Roman law. The whole 'Code' of Justinian was again studied, and Bologna in Italy became the center of the study of law in the later 11th and early 12th centuries. While these two centers reflect the influence of Mohammedan and Byzantine culture most clearly, this new learning spread rapidly through Western Europe. The Crusades hastened this spread of learning, for in the two centuries after 1095 they drew soldiers and pilgrims in vast numbers from all parts of the West to the Holy Land by way of Italy or Constantinople. The schools of the monasteries and cathedrals became greatly improved. The church once more had a literate clergy and admitted to the schools an increasing number of students who did not intend to become priests. Certain schools became especially famous, and students flocked there in great numbers, some to specialize in medicine, law, or teaching, though the majority continued to study for the priesthood.

The Rise of Universities

The great numbers of students at these more famous centers created problems which the limited facilities of monastery and cathedral schools could not meet. At Bologna, the students formed an organization, made contracts with their teachers, and adopted rules for their own government. This organization was chartered in 1158 as the University of Bologna, after Salerno the earliest university of medieval times. Another,

the University of Paris, organized soon after 1150, grew out of the cathedral school of Notre Dame, which had become famous during the early part of the 12th century because of the brilliant teaching of Abelard (*see* Abelard). It emphasized the study of theology, but also gave instruction in medicine and in the liberal arts. The latter included, according to Greek and Roman tradition, the *trivium*—grammar, rhetoric, and logic—and the *quadrivium*—arithmetic, geometry, music, and astronomy.

Universities soon grew up in other cities; first in England and Spain, later in Bohemia and Germany. Sometimes they were established by kings or princes; usually, however, they developed from the organizations formed by students or teachers or both for self-protection and for the privileges that were granted to corporations. Classes met in rented halls for lectures and "disputations" (debates). Buildings were not provided until much later. The first buildings were usually residence halls built through the generosity of wealthy men for the housing of the poorer students. These halls were called "colleges." It was only gradually that the halls came to be used for purposes of instruction and that the name "college" came to mean an educational institution.

Colorful Student Life

The life of a large medieval university like that of Paris was picturesque in the extreme. The students formed a cosmopolitan group representing at times every important nation of Europe. Quite naturally, while they received instruction in the same classes, they associated chiefly with their fellow-countrymen. The larger national groups formed societies known as "nations," among which brawls were frequent. All the nations would unite in common defense in "town and gown" fights with the rowdies of the town or, on occasion, against the guardians of the law. The student's day was a long one. Lecture periods covered two hours and the daily program usually comprised three such periods. There were no games or athletics, but the evenings were free, and since there was no supervision of the student's life outside the lecture halls, drinking, gambling, and carousing were common diversions.

The principal method of instruction was the lecture. The teacher usually read from a manuscript text (in Latin), of which there were several that were regarded as "standard" in the different fields of learning. As he read, he would comment on the statements, pointing out where other authorities differed, and often adding his own opinions. The students would diligently "take notes," for manuscript books could not be purchased except at a prohibitive cost. Supplementing the lectures were the debates or disputations (also in Latin), which seem to have been spirited exercises calling for ready knowledge and keen thought.

Notwithstanding the limitations of medieval learning—for science had made almost no advance beyond Aristotle—the early universities exerted a powerful influence upon European progress. They laid the solid foundations upon which were built the brilliant achievements of the Renaissance and the Age of Discovery.

Influence of the Gilds

Medieval education was not limited to the universities, the cathedral schools, and the monasteries. Apprenticeship training kept alive the artisan trades, and during the latter part of the Middle Ages was greatly improved through the development of the craft gilds. With the growth of the cities, the skilled craftsman came to play a very important part in the social scheme. One of the major objects of the craft gilds was to keep standards of workmanship at a high level. The apprentice was inspired with this ideal throughout the period of his training. In many of the gilds the educative influence extended far beyond the period of apprenticeship; for, in order to become a "master workman," the journeyman had to produce a piece of work recognized by the master workmen of the gild as justifying his admittance to all gild honors and privileges. The merchant tradesmen also organized associations, known as merchant gilds, which trained apprentices. (*See* Gilds.)

Training for Knighthood

A third form of apprenticeship training affected only a small part of the population. This was training for admission to knighthood (*see* Knighthood).

During the greater part of the Middle Ages, training in the arts of reading and writing was limited largely to those who were preparing to become monks or priests. Some of these served as secretaries to kings, princes, and the lesser nobility, and occasionally as tutors in their families. A few boys, too, as we have seen, were taught to read and write in the monasteries even though they were not preparing for the service of the church. As a rule, however, literacy was confined to the clergy, or the "clerical" profession (whence came the later use of the word "clerk" to mean a letter-writer or bookkeeper).

With the expansion of commerce and the growth of the cities as centers of trade, there was a greatly increased demand for persons who could read, write, and keep accounts. By this time the spoken languages of the various peoples had been reduced to writing, and some of the schools were beginning to teach the "vernacular," or native language, as well as Latin. Very soon purely vernacular schools came into existence, teaching chiefly reading, writing, and the rudiments of arithmetic. Some of these schools were controlled by the church, others by gilds, others by towns and cities, and others by private enterprise. By the close of the Middle Ages the arts of reading and writing were fairly widely diffused, although throughout Europe the masses were still illiterate.

The Beginnings of Modern Education

The 14th and 15th centuries brought the Middle Ages to a close and ushered in modern civilization. Three epochal inventions contributed to this change—gunpowder, the mariner's compass, and the art of printing. The first dealt the death-blow to the feudal system, already weakened by other forces; for even in

their armor knights on horseback could not compete successfully with cannonballs. The second made possible the voyages of discovery which were to open up the New World. The third and most revolutionary—the art of printing—brought learning within the reach of all, and made possible the rise of modern science.

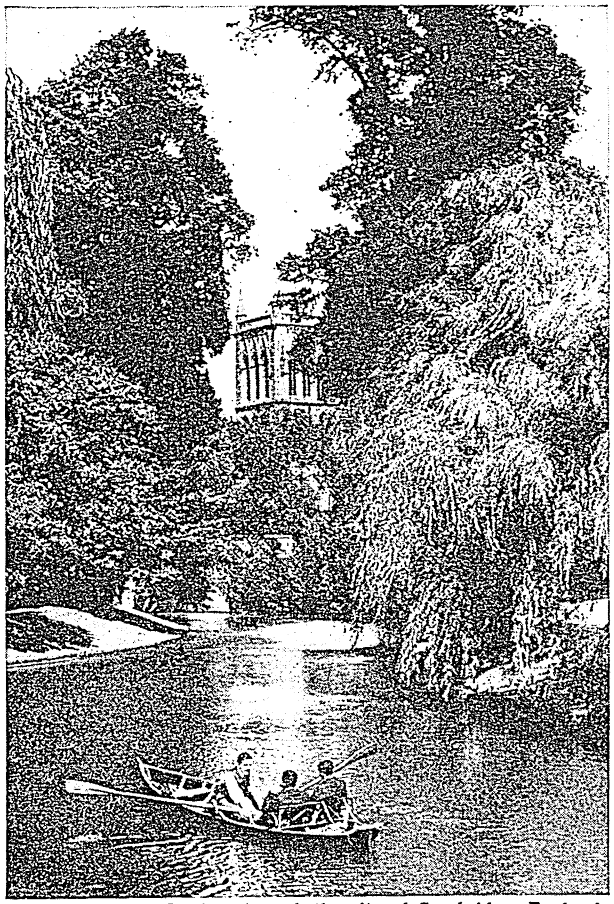
During the greater part of the Middle Ages, the literary works of Greece and Rome were practically unknown in Western Europe, although Latin remained the "language of learning" quite to the close. The textbooks which formed the basis of the lectures in the medieval universities were written in Latin and were based in large part upon the writings of Aristotle. What Matthew Arnold has called the "literature of power," however — the poems and dramas of the Greeks and the Romans —could not be reconciled with the doctrines of the church and consequently could not form a part of the medieval curriculum. The Greek language, although still taught in Constantinople, was virtually unknown in Western Europe.

Revival of Learning

In the 14th century a group of Italian scholars broke away from the tradition that the classical literature of the ancient world was useful only in teaching grammar to prospective churchmen. They searched the monasteries for Latin masterpieces that the earlier monks had copied. Some went to Constantinople to learn Greek and to copy or translate into Latin the Greek manuscripts still preserved in that city. There came about, then, the Renaissance, or "new birth," of classical literature and art. The revival spread, although not rapidly, to other countries. (*See* Renaissance.)

The Renaissance had a profound effect upon education of the more advanced type. Schools and universities of the Middle Ages had been very largely dominated by the church and by the religious ideal, which was essentially "other-worldly." The spirit of the Renaissance was a deep interest in human life as it is actually lived in this world, and for this reason the movement is often referred to as Humanism and its leaders are known as Humanists. To this day the study of the languages and literatures of different peoples in the higher schools and colleges is often referred to as a study of the "humanities."

A FINE VISTA AT CAMBRIDGE



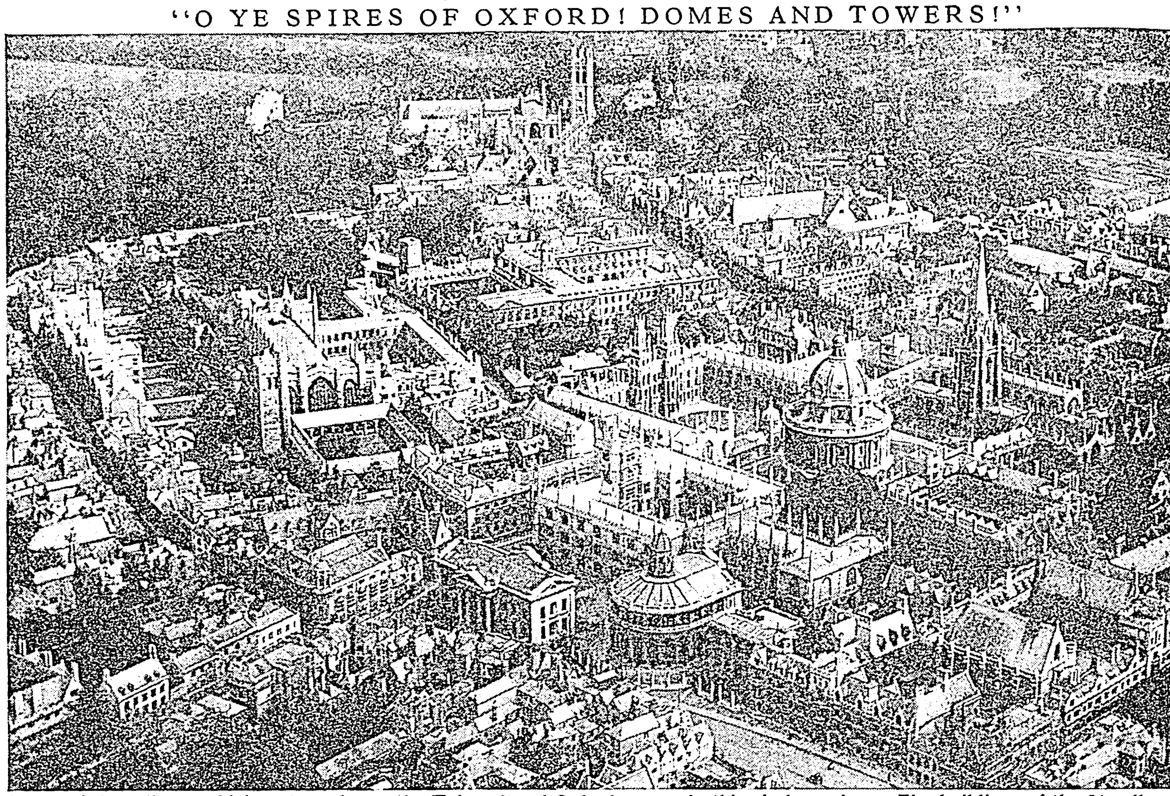
The river Cam, flowing through the city of Cambridge, England, adds beauty to the setting of this famous university. In the background is the New Chapel of St. John's, oldest of the colleges that make up Cambridge University.

Although the first of the great Humanists, the Italian scholar Petrarch, did his principal work in the first half of the 14th century, the influence of Humanism on the schools of northern Europe was not strongly felt until the beginning of the 16th century. Then the Greek language, which had been taught in several of the universities for some time, became an important subject in a number of the schools which prepared students for the universities. Such schools came later to be known as "secondary" schools. In England they were called "grammar" schools; in Germany the typical secondary school was known as the *gymnasium*.

The secondary schools in many cases had grown out of the older cathedral and monastery schools which trained the clergy. They continued to teach Latin and theology, but their programs were now broadened to include the Greek language and some of the Latin classics. For a long time only slight attention was given to the mother tongue. The general curriculum pattern which grew up in the 16th century under the stimulus of the Humanists has prevailed until the present time in the typical secondary schools of Great Britain and the Continent. The Latin and Greek languages and literatures still remain the basic elements, with the addition of mathematics. More attention is paid to the mother tongue than in the earlier days, and science receives some slight recognition. We are speaking here of such schools as the German *gymnasium*, the French *lycée*, and the famous "public" schools of England—which are not public schools at all in our usage of the term but endowed secondary schools. There are today in all of these countries other types of secondary schools that emphasize particularly the study of the sciences and of the mother tongue.

From the outset the secondary schools of Europe have been, in the main, schools for the privileged classes in that they have charged relatively high tuition fees, which have excluded the poorer children. In some countries, however, and especially in Great Britain, scholarships have for a long time been available to all on the basis of competitive examinations.

"O YE SPIRES OF OXFORD! DOMES AND TOWERS!"



Many of the colleges which go to make up the University of Oxford appear in this airplane view. The buildings of the 21 colleges are each arranged in the form of a quadrangle, or a series of quadrangles. The oldest, University College, dates from 1249, though the history of the University of Oxford goes back at least a century before this time.

Although the spirit of Humanism was essentially liberal and distinctly a protest against the formalism that characterized the schools of the Middle Ages, the secondary schools born of the Humanistic movement soon acquired a formalism of their own. The early stages in the study of such languages as Latin and Greek require a certain amount of pure memorizing, and for many students this period of formal drill is prolonged and may never result in that degree of mastery which is necessary to the appreciation of literature. Learning by rote and without understanding may easily become a habit under these conditions. Nevertheless the classical secondary schools of Europe have been and still are in many ways the best schools in the world.

Effects of the Reformation

Close upon the heels of the Renaissance came another series of changes in the pattern of education. For a thousand years the Roman Catholic church had been supreme in Western Europe. In the 16th century several groups broke away and established churches of their own. This movement which separated them from the Catholic church is known as the Protestant Reformation (*see* Reformation, Protestant).

One effect of the Reformation was to improve the schools and methods of teaching among both the Catholics and the Protestants. Among the Catholics there arose a number of "orders," the members of which devoted themselves largely or wholly to teaching. Of these the Jesuit order was the most important. Its aim was to extend the faith by missionary work and then through education to keep the converts and especially their children firm in the faith. Secondary schools and colleges organized and controlled by the Jesuits sprang up in all Catholic countries. Especial attention was given to the training of teachers and the improvement of teaching methods. Instruction was thorough, and while memorization was demanded the learners were made to understand what they were learning. Systematic reviews were instituted, from day to day, from week to week, and from year to year. The brutal methods of discipline prevalent in the schools of that time were not practised by the Jesuits. Learners were encouraged to compete with one another both in their studies and in good conduct. The schools were free to everyone who cared to attend and could meet the standards. All in all, the Jesuit schools were probably the most thorough educational institutions in Europe over a period of about 300 years.

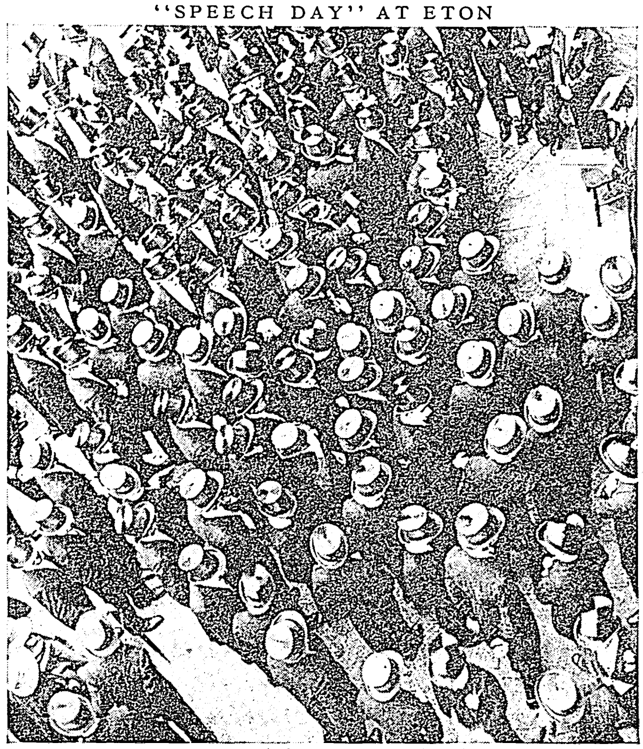
Other teaching orders, such as the Christian Brothers, also made important contributions to educational progress.

Under the leadership of Martin Luther many reforms were made in the secondary schools of northern Germany and other regions where the Protestants predominated. Perhaps the most far-reaching influence of Protestant education was the insistence on teaching everyone to read. This came from the basic principle laid down by Luther that each person should interpret the Bible for himself, and to interpret the Bible one must be able to read it. The ideal of universal literacy was not realized even in Germany for 300 years, but throughout the Protestant world except in England the need of elementary schools for the masses of the people came to be more and more fully recognized.

Schools in England

Although England had no thoroughgoing system of elementary and secondary education until 1872, schools of various types came into existence soon after the introduction of Christianity by St. Augustine (597). Most of these were under church control and were conducted by parish priests, monks, and other members of the clergy. Some were supported by endowments contributed by individuals or groups. After the Reformation private and charity schools were established in great numbers. Preparation for the universities was largely the concern of the great "public" endowed schools, such as Winchester, Eton, Westminster, Harrow, and Rugby. These schools, many of which still exist, are "public" only in the sense that they are independent of church or state control, not that they give free tuition. In fact, they correspond somewhat to the expensive "private" schools of the United States, and draw their pupils chiefly from the upper and upper middle classes.

"SPEECH DAY" AT ETON



Silk toppers and tail-coats—their everyday garb—give a grown-up look to these Eton lads at the annual "Speech Day" celebration. Eton, largest of English public schools, was founded by Henry VI about 1440. Many generations of men who later became leaders in public life received their early training at this famous institution.

The "Dame" Schools

A type of English elementary school which is interesting and important because it was transplanted to the American Colonies is the "dame" school. As a result of the widespread demand among the common people for the instruction of their children in the rudiments of learning, many women set up schools in their homes, teaching the elements of reading, spelling, writing, and arithmetic in return for a small fee.

Education in Colonial America

The English colonization of North America began at a time when the changes wrought by the Renaissance and the Protestant Reformation in Europe were still relatively new. The earlier struggles between Catholics and Protestants had been followed by dissensions and rivalries among the various Protestant branches. It was one of these — the quarrel between the Puritans and the Separatists on the one hand and the Established Church of England on the other hand—that led to the settlement of New England.

The leaders of the New England colonists were well educated and the ideals of both Puritans and Separatists were distinctly favorable to education for all classes. The Separatists, before establishing the Plymouth colony, had lived for some years in Holland, where the ideal of universal literacy had already gained a footing. The Jamestown colonists, on the other hand, adhered to the Established Church of England, the educational ideals of which at that time were aristocratic rather than democratic; schools were for the upper classes that supplied the leaders, not for the common people.

The American system of universal, free, and tax-supported education had its origin in Massachusetts, but for a long time it was more an ideal or a pattern than an actual accomplishment.

Boston Latin School; Harvard

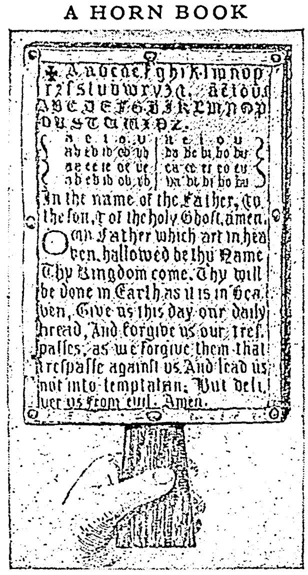
In 1635, five years after the founding of the Massachusetts Bay Colony, the Boston Latin Grammar School was established and in the following year Harvard College was founded.

Elementary instruction in reading was at first provided by parents and by private teachers, but in 1647 the colonial legislature passed a law requiring each town of 50 families to maintain an elementary school and each town of 100 families a secondary (Latin grammar) school, and to provide for at least the partial support of these schools by taxation. We have

here the essential features of present-day American education, with three exceptions: (1) there was apparently no compulsion to attend school; (2) a tuition fee could be collected from those who were able to pay; (3) the primary purpose of the schools was religious and they were closely allied with the church.

The other New England colonies followed in general the lead of Massachusetts, except Rhode Island, in which for a century or more the provision of educational facilities was left to the parents of the children, the local communities, and charity.

A HORN BOOK



The horn book, made of wood with its lettered vellum page covered with a thin sheet of horn, taught children to read from Chaucer's day until the age of widespread printed textbooks. Beginners today would find the Lord's Prayer difficult reading.

Schools in New Netherland and Pennsylvania

In the Dutch settlements of New Netherland, provisions for education followed the plan that prevailed in Holland. Each church had attached to it an elementary school and in a few cases a Latin grammar school. These were supported and controlled jointly by the church and the colonial government. The ideal of universal education might have been more nearly approached in New Netherland than in New England had it not been for the English conquest through which New Netherland became New York. The English governors were not sympathetic with the idea of universal education, and although the Dutch churches were permitted to continue the schools, public support was largely withdrawn. It has been said that the English occupation of New York probably set public education back a hundred years.

William Penn's plan for the government of Pennsylvania made a distinct provision for universal education, but the provision, before it went into effect, was so modified that it applied only to those children whose parents could pay for their tuition. Unlike most of the other colonies, Pennsylvania from the outset permitted religious freedom, and the population was divided among a number of different faiths. Some of these, and especially the Quakers, established church schools chiefly of elementary grade. Secondary schools and colleges were gradually provided but the ideal of public, free, universal education remained far in the future.

Attitude of Virginia; the South

In Virginia, as we have seen, the notion of education as a class privilege prevented the establishment of free schools. An oft-quoted statement of Sir William Berkeley, governor of Virginia, expressed this notion in an extreme form. When asked how education was provided for he replied: "The same course that is taken in England out of towns; every man according to his ability instructing his children. . . . I thank God there are no free schools, and I hope we shall not have them these hundred years; for learning has brought disobedience and heresy and sects into the world." The other Southern colonies in the main disposed of the problem in the same way. Parents who could afford the expense either sent their children to private schools or employed private tutors. The children of the poor remained illiterate. The colonies of Maryland and South Carolina at different times attempted to establish systems of public education, but without success.

The strictly religious purpose of the early colonial schools made the reading of the Bible in the mother tongue the chief objective of elementary education, and the study of Latin in preparation for college and ultimately for the ministry the chief objective of secondary education. In many of the elementary schools, only the merest rudiments of reading were taught; even writing was not attempted. It was not until about 1750 that arithmetic was generally added to the curriculum, and geography did not appear as a recognized school study until close to the beginning of the 19th century.

Generally, the teachers of the elementary schools were men of very slight education; their methods of instruction were crude; their discipline was often brutal. Conditions in the secondary schools were much better in so far as the preparation of the teachers was concerned; the methods, however, were usually of the formal "memoriter" type.

The Spread of Universal Education

We have seen how the ideal of universal education had its faint beginnings in the Protestant Reformation, and we have traced the short and uncertain steps that were taken toward the realization of this ideal in the American Colonies. Even in New England, public interest in the common schools declined with the waning influence of the Puritan church in the affairs of government. When the United States became an independent nation in 1783, the proportion of illiterates in the population was still high.

Moreover, at that time the situation was not much better in the more advanced countries of Europe, although in Holland, the Scandinavian countries, and some of the German states measurable progress had been made. Free, tax-supported, universal education is usually thought of as essentially a democratic ideal; and yet it was the autocratic ruler of one of the most aristocratic of all states, Frederick the Great of Prussia, who first decreed that all children of his kingdom should attend school for at least eight years. He, however, was unable to enforce this decree, and an effective system of popular education was established in Prussia only after her defeat by Napoleon in 1803. Then the eloquent pleas of the patriot-philosopher Fichte convinced the German people that their future hope lay in the provisions that they made for education. Both in America and in Europe, then, universal

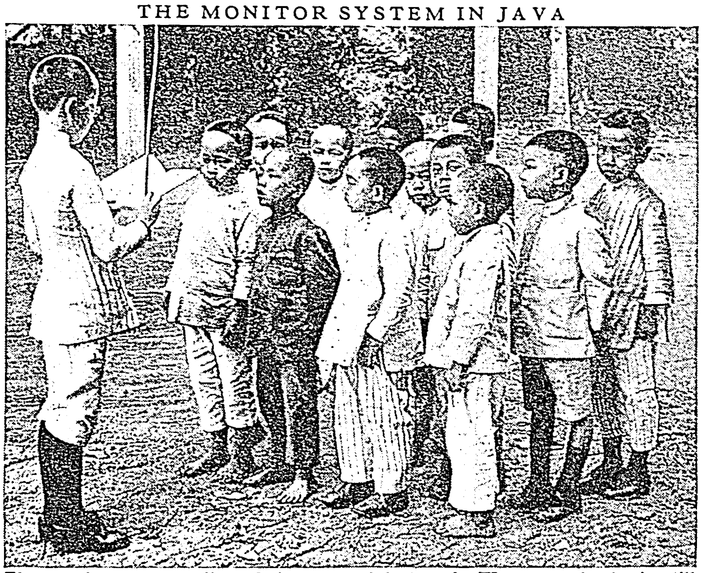
education is essentially a child of the 19th century. Just as the defeat of Prussia by Napoleon led to the educational awakening of Germany, so the defeat of France by Prussia in 1870 led France to establish the universal school. Although church schools and philanthropic enterprise greatly reduced illiteracy in England during the first half of the 19th century, England did not have a thoroughgoing system of public elementary education until 1872. In many other nations, especially those of southern and eastern Europe, the masses still remain largely unschooled.

Land Grants for Schools

The fathers of the American republic—such men as Washington, Jefferson, Madison, and John Adams—recognized clearly enough that a government based upon the votes of the people would be doomed to failure unless the people as a whole were in some measure educated, and they repeatedly urged the development of schools and colleges. Even before the ratification of the Constitution, the Congress under the Articles of Confederation adopted in 1785 the Land Ordinance, which provided for surveying the public lands north of the Ohio River, and for setting aside $\frac{1}{36}$ of each township for the support of schools (*see* Northwest Territory). In this and other ways, the new national government fostered public education. As a federal government, however, it did not have the right to control education; this important duty was left to the several states.

Notwithstanding these recognitions, the universal school was of slow growth, both in the new states of the Middle West and in the original states of the Atlantic seaboard. The settlers in the West were too busy clearing land and building homes to give much thought to schools. Then, too, until the country was settled and developed, the lands set aside for the support of schools were of slight value. In the older states little progress was made beyond the conditions that existed in colonial times, and in New England the schools seem actually to have gone backward. The notion of education as essential to citizenship under a democratic form of government had not as yet made a strong appeal, for universal manhood suffrage was itself only gradually established. Throughout the country, schools and teachers were usually available for the children of those who could afford the tuition charges, but in many regions there were no free, tax-supported schools. Even where such schools were maintained, they were usually poorly taught and were limited to the elementary subjects of instruction. Free schools were almost everywhere regarded as charitable institutions and were sometimes slightingly referred to as "pauper" schools or "ragged" schools.

THE MONITOR SYSTEM IN JAVA



The monitor system, discarded as unsatisfactory in Western schools, is still used in schools conducted by the Dutch government in Java. Bright as this 12-year-old monitor looks, he is scarcely equipped to teach a class.

The Monitor System

Early in the 19th century, an attempt was made to solve the problem of free schools by adopting a plan that seemed at the time to promise rich results. The largest single item in the school budget is the teacher's salary, and if we marvel at the tardiness with which free, tax-supported, universal education arrived, it is well to remember that it costs a great deal of money to provide competent teachers for "all the children of all the people." Joseph Lancaster, an Englishman, believed that the expense could be greatly reduced by having the older pupils teach the younger pupils. Thus one teacher could bring a group of pupils up to the point where they had mastered the elements of reading, writing, and arithmetic; then another group of beginners could be taught by the first group, who would also receive more advanced instruction from the teacher. When the second group reached the desired degree of proficiency, a third group of beginners was received. In this way it seemed possible to provide schooling for the great masses of children at relatively small cost. Lancaster developed his scheme elaborately, training successive groups of pupil-teachers or "monitors" carefully and devising ingenious solutions for the problems of school management and discipline. This Lancastrian or "monitorial" system was adopted in New York, Philadelphia, and a few other American cities. It was soon found, however, that instruction given by immature pupils to their younger fellows, even when carefully planned and organized, was at best very formal and at its worst confusing and meaningless.

Development of Free Public Schools

It was not until well on in the 19th century that public elementary education began to show signs of progress. The change came first in New England and several forces were responsible for it.

(1) Immigration was bringing to the country, especially the North Atlantic states, an ever-increasing number of foreigners unfamiliar with American life, customs, and government. Many of them could not speak or write the English language. The problem of making these immigrants—and more particularly their children—into American citizens impressed even those who had hitherto objected to paying taxes for the support of schools in the belief that education was the concern of the parents and not of the public. The immigrants, most of whom were both poor and ignorant, obviously could not do much to train their children for American citizenship; it seemed inevitable that public enterprise and the public purse must assume the responsibility.


HORACE MANN

(2) At the same time, in the northeastern section of the country, manufacturing was rapidly expanding. Early in the century, power-driven machinery had ushered in that momentous series of changes known as the Industrial Revolution. Factories sprang up, particularly along the "fall line" of the New England rivers where water power could be easily developed, and later in the towns along the coast to which coal could be brought cheaply by boat. Many farmers moved into the towns and cities where they and their children could find work in the factories, and in these centers many of the immigrants settled. Under the conditions of urban life, with its division and specialization of labor, the ability to read, write, and "cipher" became imperative in the business of making a living. The working classes recognized this need and began to demand for their children schools that would be both free and tax-supported. The demand for tax-supported schools came partly from a desire that the stigma of accepting charity might not attach to those who attended them.

(3) Americans who were interested in universal education kept close watch of the developments in Europe, especially in the German states, in which after the Napoleonic Wars the development of public education on a universal basis proceeded very rapidly.

These and other influences resulted between 1830 and 1840 in what has been called the "Common School Revival." As applied to New England, this term is appropriate, for public education had actually deteriorated there, but as the movement spread to other parts where there was little or nothing to "revive," it became, so to speak, an original force.

Work of Horace Mann

The great leader of this movement was Horace Mann, a young lawyer who gave up his practise to become secretary of the Massachusetts state board of education. With Mann, the idea of free, universal education was almost a religion. Both girls and boys, rich and poor, he believed, should have equal educational opportunities. He wished the public schools to be so good that even wealthy parents would prefer them to private schools. Thus, the children of all classes would attend the same school and the notion of the free school as a "charity" school would no longer be justified. School buildings, he believed, should be well built and well equipped. Above all, teachers should be carefully trained in their profession and in the art of governing without brutal discipline. Mann went up and down the state urging the people to make more generous provision for the common schools and showing teachers how to improve their methods. In his annual reports he told how school buildings should be constructed and how the various subjects should be taught. He visited Germany and brought back many suggestions for making the schools better. (*See* Mann, Horace.)

The time, as we have seen, was ripe for this new development, but a leader like Horace Mann, fired with a missionary zeal and able to convert people to the ideals that he espoused, was necessary to bring it about. Largely as a result of his labors, Massachusetts before 1850 had the best system of public schools in America and probably one of the best in the world. Buildings were greatly improved, a large proportion of the children of school age were in school (although attendance was not as yet compulsory), the average school year had been lengthened by a month, and teachers' salaries had been increased by a half, sometimes by nearly two-thirds.

First State Normal School

In 1839 the first state normal school in the country was opened at Lexington, Mass., and three others were opened within the next two years. One of the hardest struggles of Mann's career centered about the normal schools. The German states had established such schools for training elementary school teachers, but the German states were ruled autocratically by kings and princes who could dispose of public funds much as they pleased. Massachusetts was a complete democracy, and the people decided how their tax revenues should be spent. Their representatives in the legislature hesitated whether to continue or close the tax-supported normal schools. There was a bitter struggle, but Mann and the other leaders in the fight for universal education finally won. It was a momentous victory. The controversy had been watched with deep concern by the friends of free education in Europe. A writer in the *Edinburgh Review* stated that if Massachusetts had failed, the cause of democracy would have received its worst setback since the excesses of the French Revolution.

Although Mann's work was primarily concerned with the elementary schools and the training of teachers

for these schools, secondary education was not neglected. In early colonial times, the only secondary schools were the Latin grammar schools, which prepared boys for college. In the second half of the 18th century there appeared a new type of secondary school, known as the "academy." This was primarily a "finishing" rather than a "fitting" school; that is, it aimed to prepare those attending it for the actual business of life rather than for the advanced training of the college or university.

Its program was broader; it gave less attention to the classical languages and more to modern languages, the sciences, and mathematics—especially such forms of applied mathematics as surveying and navigation. The academies, which were widely distributed throughout the country by 1825, were private institutions usually endowed by wealthy persons. Though scholarships sometimes made them available to exceptional children of poorer families, they were essentially schools for the privileged groups.

Beginning of Public High Schools

In 1821 Boston established the first public high school in the United States. This school, patterned after the academies, did not at first prepare for college; it offered, rather, a variety of courses of the modern (non-classical) and practical type. In 1827, the Massachusetts legislature passed a law requiring towns of a certain size to establish high schools. Few of the towns acted upon this law until Mann became secretary of the state board of education, but by 1850 Massachusetts had 64 public high schools—probably more than all the other states combined. The high schools later undertook to prepare pupils for college, and thus combined the functions both of the old Latin grammar schools and of the private academies. In the country as a whole, the high school made little progress until after the Civil War.

The early high schools were not so closely related to the elementary schools as are the high schools of today; that is, one did not pass through six or seven or eight "grades" of elementary education and then enter high school. In fact, the grading system was not developed until the latter part of the 19th century. For a long time the high school was a "selective" school, in that admission requirements were such as to exclude all but the more competent. Gradually the public high schools became, in effect, upward extensions of the elementary schools, and one who had completed satisfactorily the work of the latter could enter high school without further formalities. For a long time, however, the high schools were attended by only a small proportion of the children of high-school age. Relatively few pupils remained in the elementary schools more than five or six years; and outside of New England and the larger cities elsewhere, public high schools were not numerous until late in the 19th century.

Influence of Comenius and Rousseau

Universal elementary education both in Europe and in America was powerfully influenced by the teachings and practises of a few great leaders whom we may call educational reformers. Three stand out conspicuously: Johann Comenius (1592–1670); Jean-Jacques Rousseau (1712–1778); and Johann Heinrich Pestalozzi (1746–1827).

Comenius was a Czech, a native of Moravia (part of the German protectorate of Bohemia and Moravia), and a bishop of the Moravian church. He was an advocate of education for all—for "boys and girls, both noble and ignoble, rich and poor"; and he set forth in a book, 'The Great Didactic', a detailed plan for the organization of a complete educational system. Every hamlet and village was to have a vernacular school which would enroll all children between the ages of 6 and 12. In every city there would be a secondary or Latin school for pupils between 12 and 18, and in every kingdom or province a university. Comenius also did much to improve the teaching of his time, and especially to relieve its formalism and make it more meaningful. To this end he made large use of pictures, and he wrote and published the first illustrated school textbook (*see* Literature for Children). He became well known throughout northern Europe and the American Colonies, where he exerted a wide and beneficent influence. His memory is still revered in his native land; and it is due in no small part to his pioneer work that the Czechs have long been among the most highly literate peoples of Europe.

Rousseau was the most radical of all rebels against formalism and artificiality both in life and in education. Living in Paris in the reign of Louis XV, he was impressed by and disgusted with the extravagances of the royal court and the nobility. On the one hand were the poverty and squalor of the great masses; on the other, the superficiality, the empty formalism, and the affectation of what was deemed at the time the most advanced civilization in the world. Rousseau concluded that what was called civilization really meant the reverse of progress, and that man would be far better off in his "natural" state. "Everything is good as it comes from the Author of Nature; but everything degenerates in the hand of man."

Rousseau was a brilliant writer, and his books on the evils of the times and ways of remedying them speeded the revolt against the oppression and exploitation of the masses which had its climax in the French Revolution of 1789.

The Story of Émile

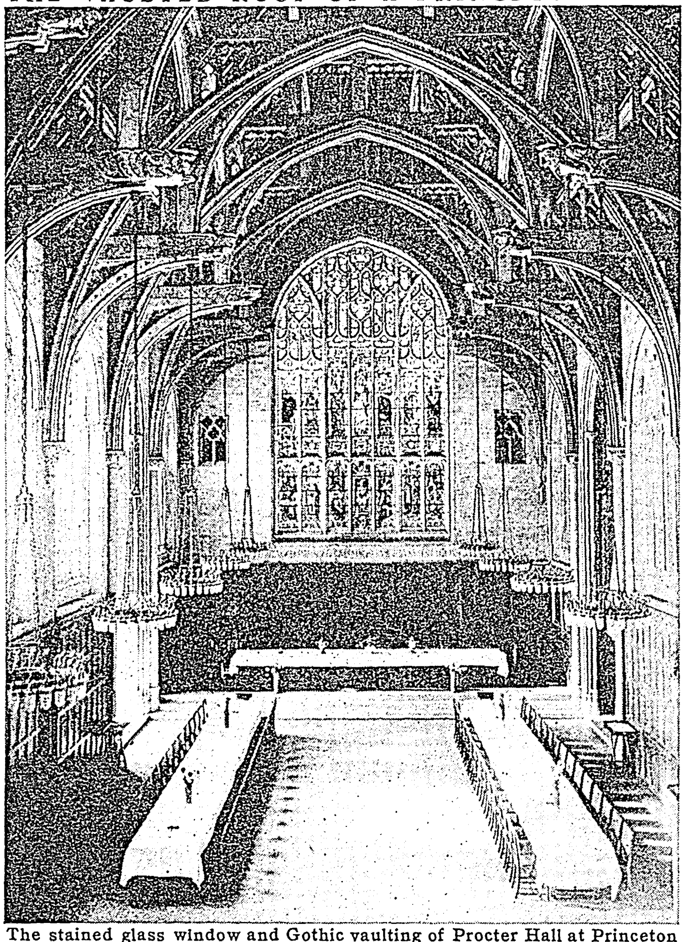
His influence upon education was exerted chiefly by a remarkable book, 'Émile', in which he describes what he considers to be the ideal training of a boy from infancy to manhood. His idea of a saner and simpler education had a great appeal.

Education, according to Rousseau, should follow as closely as possible the patterns set by nature. The natural impulses and urges of human nature are, in his belief, inherently good; only when they become spoiled by civilization are they bad. He would have Émile's early life spent among natural surroundings far from towns and cities. Émile is to play athletic games in order to develop hardiness, robust health, and keen

senses. Discipline must be through the "natural consequences" of his acts. If he breaks dishes let him get along without them; if he lies let him be distrusted even when he tells the truth. He will learn to read only when he feels the need of reading. There comes a period between 12 and 15, Rousseau believed, when every normal child will have a natural interest in rational knowledge and then he may be taught something of science. Astronomy may interest him if he gets lost in the forest and has to rely on the sun or the moon to find a way out; then he will wish to learn all about the heavenly bodies. At least, this was the theory held by Rousseau.

These are but suggestions of Rousseau's elaborate plan for bringing Émile from infancy to manhood, but they exemplify his educational theory. Similar doctrines had been advocated by groups of German educators a century or more before Rousseau wrote his great masterpiece. Rousseau's fame as an educational reformer has been due not so much to the novelty of his teachings as to the engaging manner in which he set them forth, and to the striking contrast between his proposals and the formalism which characterized both the life and the education of his time.

THE VAULTED ROOF OF A PRINCETON HALL



The stained glass window and Gothic vaulting of Procter Hall at Princeton University, illustrate how the Old World charm and dignity of English college architecture have been carried over into one of America's old and famous institutions of learning.

Rousseau had little immediate influence on school practise but many of his theories are strongly reflected in the teachings of later reformers and for better or for worse have powerfully affected present-day education in the United States, where they find expression particularly in the so-called "progressive" schools, and in the Soviet Union, where they dominate a vast school system that is still in the experimental stage. (*See* Rousseau, Jean-Jacques.)

Pestalozzi's School and Methods

The great Swiss reformer Pestalozzi became interested in education through reading Rousseau's 'Émile'. Early in life he had become ambitious to do something to relieve the poverty and distress of the lower classes. He came to the opinion that education was the only solution of the problem—not education of a merely bookish sort, but of a broad type that would enable the poor to make a better living and to lead better lives. At the age of 28 he opened his home to a score of children from very poor families. He fed and clothed and taught these children; he lived with them as a father with a large family. He taught the boys farming and gardening; the girls were trained in housework and in sewing. All were taught the basic school subjects in the intervals of work and sometimes in connection with the work that they were doing. He later directed an orphans' home at Stanz, where he continued to combine instruction with manual labor. It was here that he worked out his theory that learning should be primarily a process of experiencing or observing rather than memorizing. Rousseau had said as much or more, as had others before him, but the schools continued to teach very largely through books, inclining toward formalism, as in the past. Pestalozzi, however, did more in a practical way to mitigate the evils of formalism than had any educator before him. He did not deny the value of books or the value of teaching through language; in fact, he laid great emphasis upon oral instruction. But by insisting that such teaching should be preceded by or at least accompanied by experience with things, he did a great deal to make school instruction more effective.

Pestalozzi's later schools at Yverdon and Bergdorf became widely known, and were visited by teachers from all parts of Europe. In the new awakening of education in Prussia his theories and methods had much influence. Americans became acquainted with them early in the 19th century, and Horace Mann learned more about them while in Germany and wrote

a report about them when he returned. The Pestalozzian influence was much more strongly felt, however, a generation later through the training of teachers at the Oswego State Normal School (founded in 1861) which, under the leadership of Edward A. Sheldon, emphasized Pestalozzi's teachings from the time it was established.

Among the later reformers who were strongly swayed by the writings of Rousseau and Pestalozzi were Johann Friedrich Herbart (1776–1841), a German philosopher and psychologist, who did much to refine and improve methods of instruction, and Friedrich Wilhelm Froebel (1782–1852), the "Father of the Kindergarten" (*see* Froebel, Friedrich Wilhelm; Kindergartens and Nursery Schools). The teachings of both of these men exerted a powerful influence on American education. The general tendencies represented by Rousseau, Pestalozzi, and Froebel are most strongly reflected today in the educational theories of John Dewey and his followers.

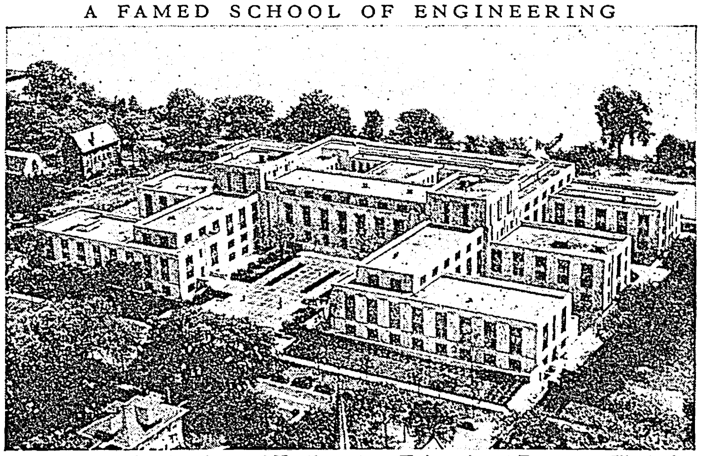
Colleges, Universities, and Professional Schools

The colleges established in colonial times were primarily for the training of the clergy. In New England the Puritans founded Harvard (1636) and Yale (1701). In New York, King's College (now Columbia) was founded by the Church of England (1754). The College of New Jersey (1746), which later developed into Princeton University, was a Presbyterian institution. At Williamsburg, Va., the College of William and Mary (1693), the second college to be established in the English colonies, represented the Church of England.

The colleges of the colonies, like the universities of Europe, in time attracted students other than those who planned to enter the ministry. The training they provided in Latin, Greek, and mathematics was found to be a desirable foundation for the professions of medicine and law. Several of the framers of the Constitution were graduates of these colleges.

There were no professional schools of the kind that are numerous today. A young man who wished to follow the law entered the office of a practising lawyer, where he mastered his profession much as artisans learned their trades by apprenticeship. Physicians were similarly prepared for their calling. Dentistry was still a branch of medicine, and schools for nurses were unknown. Surveying was taught in some of the colleges and secondary schools; other branches of engineering were neglected. A few normal schools for the training of teachers had been established in Europe, but such schools were unknown in America until well on in the 19th century.

A FAMED SCHOOL OF ENGINEERING



The Technological Institute of Northwestern University at Evanston, Ill., trains students in the chief branches of engineering—civil, mechanical, chemical, and electrical. The Institute operates on the "work-study" plan, which permits the young engineers to alternate periods of study with periods of work.

After the Revolution, colleges multiplied more rapidly and became more pronouncedly institutions of general education. The Ordinance of 1785 set aside land in each township for the support of common schools; two years later Congress granted land for the endowment of a university in the territory that later became the state of Ohio; and Ohio University was opened at Athens in 1808. With the admission of other states, similar provisions were made. One of the most famous of the state universities, the University of Michigan, was planned as early as 1817, while the present state was still a territory, but was not opened until 1841. While the original 13 states did not profit by these early land grants from the Federal government, North Carolina established a state university in 1795; Georgia followed in 1801; and four years later South Carolina did likewise.

Privately endowed colleges and universities also grew in numbers. The Academy of Philadelphia, founded in 1751 largely through the enterprise of Benjamin Franklin, became the University of Pennsylvania in 1791. Although this institution later received state aid it is not under public control. Other colleges of this kind established in the 18th century are Brown (1764), Williams (1793), Bowdoin (1794).

Coeducation in the Colleges

For a long time the privileges of higher education were designed solely for men. Girls attended the elementary schools, and separate secondary schools for girls had been established, but it was not until 1833 that the first college (Oberlin) admitted women. Up to the time of the Civil War only four or five colleges had followed Oberlin's example. Even the publicly supported state universities excluded women. The University of Wisconsin admitted them to its normal department in 1867, and in 1870 the University of Michigan admitted women to all courses. All the state universities of the North and West soon followed suit. In the South few of the higher institutions, except the teachers colleges and normal schools, are even now coeducational, although many of the Southern states have colleges for women.

The first school of law was established at Litchfield, Conn., in 1784; the

first school of medicine, the Medical College of Philadelphia, was established in 1765. Few professional schools of law and medicine, however, appeared before the beginning of the 19th century.

Engineering and Natural Sciences

With the invention of the steam engine and the rapid extension of railroads, both civil and mechanical engineering demanded recognition. The first school for the training of engineers—the Rensselaer Polytechnic Institute at Troy, N. Y.—was opened in 1825. For the training of army officers, the Federal government established the Military Academy at West Point in 1802. In 1845, the Naval Academy at Annapolis, Md., was founded.

During the first half of the 19th century interest in the natural sciences increased. As increasingly accurate knowledge accumulated in this field, the colleges and universities began to broaden the older curriculum of Latin, Greek, and mathematics and to include brief courses in one or more of these sciences. This recognition had to overcome, however, the opposition of those who were wedded to the older order. For a long time the instruction in science was limited to textbooks and lectures with occasional demonstrations. The elaborately equipped laboratories which we find today, not only in colleges but in high schools, were unknown even in the most progressive universities until well after the period of the Civil War.

Agricultural Education

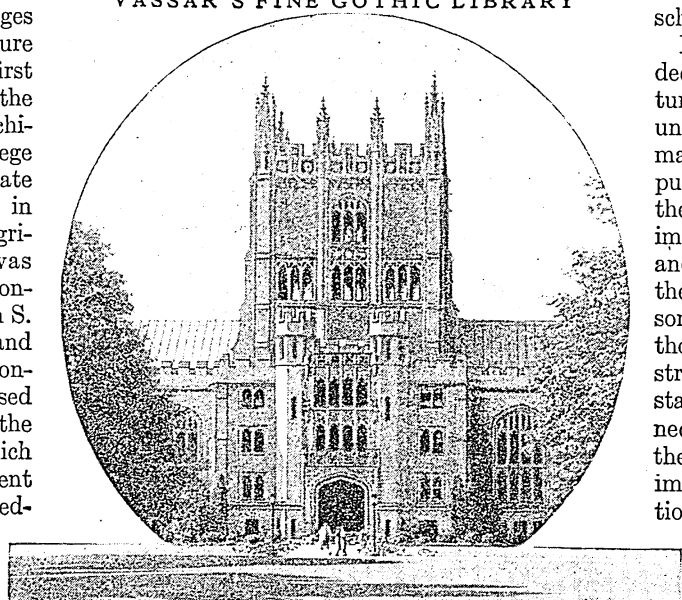
Advances in chemistry, physiology, botany, and zoölogy led to an understanding of some of the processes involved in the growth of plants and animals. By the middle of the century, this knowledge had grown to such proportions that it could be used profitably in farming, and a demand came for colleges where scientific agriculture might be taught. The first college of this type in the United States, the Michigan Agricultural College (now the Michigan State College), was opened in 1857. The need for agricultural education was ably argued before Congress by Senator Justin S. Morrill of Vermont, and after some years of consideration Congress passed what is known as the First Morrill Act, which was signed by President Lincoln in 1862. The Federal government still owned a great deal of land in the states carved from the Northwest Territory and much more in the areas acquired by the Louisiana Purchase and by purchase from Mexico at the close of the Mexican War (*see* Lands, Public). The Morrill Act gave to each state 30,000 acres of these public lands for each senator and representative of the state in Congress. This grant was for the establishment of a college in which agriculture and the "mechanic arts" should be the principal subjects of instruction. Later legislation supplemented the original land grants; and each state today receives an annual subsidy of $50,000 plus additional sums voted by Congress each year under the Bankhead-Jones Act of 1935. These are based on the population of the state and may range from $20,000 to more than $150,000.

In Massachusetts federal aid is divided between the state agricultural college and the Massachusetts Institute of Technology (not a state institution) which teaches the engineering sciences. In several cases, state universities have grown out of "land grant" colleges; for example, the universities of Illinois, Maine, New Hampshire, Maryland, and Arkansas. Separate "land grant" colleges (now commonly called the "state college" as distinguished from the "state university") are found in 20 of the states.

Educational Developments in the 20th Century

The close of the last century found elementary education universal in most of the countries of northern and western Europe, in the Northern and Western states of the American Union, in Canada, Australia, and New Zealand, and in Japan. Three countries of South America—Uruguay, Chile, and Argentina—had made substantial progress toward this goal. In the countries of southern and eastern Europe, throughout Asia, and in the larger part of Central and South America, the masses were unschooled and illiterate.

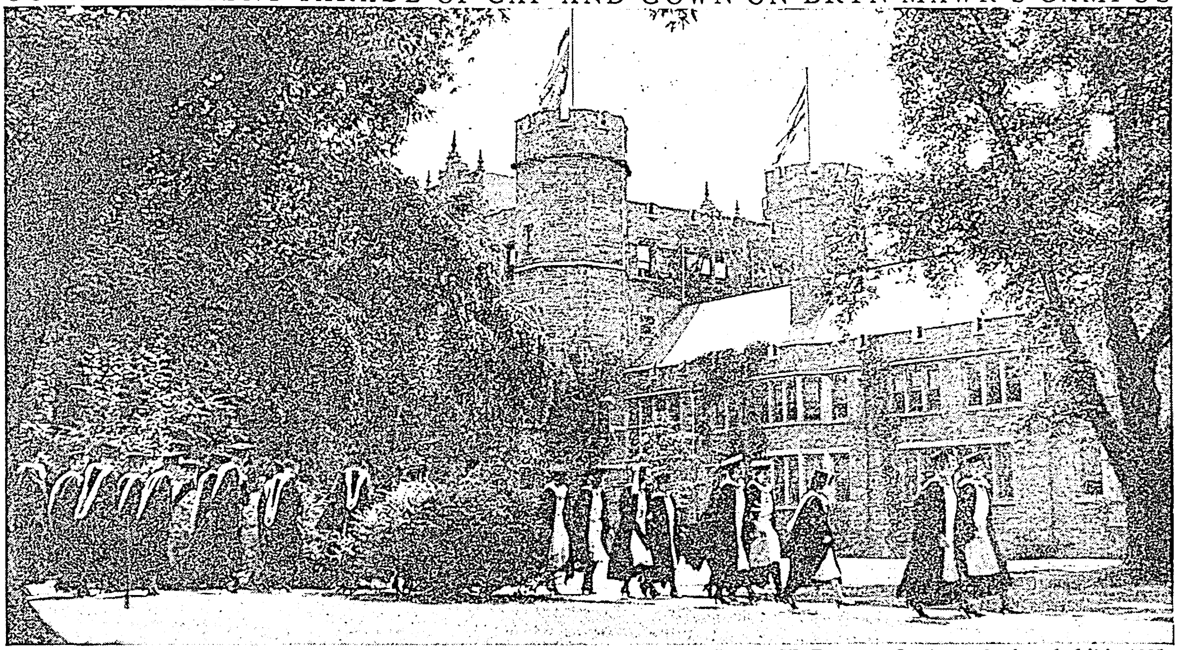
VASSAR'S FINE GOTHIC LIBRARY



One of the oldest of women's colleges in the United States is Vassar, near Poughkeepsie, N. Y., founded by a gift of Matthew Vassar in 1861. The beautiful Frederick Ferris Thompson Memorial Library pictured above houses more than 160,000 volumes and has space for 600 readers.

During the first three decades of the 20th century American education underwent a series of remarkable changes. The public school systems of the Southern states were improved and extended, and by 1920 every state in the Union had a compulsory education law. Although these laws were not strictly enforced in some states, especially in connection with Negro schools, the situation was greatly improved, and the proportion of illiteracy among adults was substantially reduced. In the Northern and Western states, great advances were made also in elementary

COMMENCEMENT PARADE OF CAP AND GOWN ON BRYN MAWR'S CAMPUS



Bryn Mawr College, at Bryn Mawr, a Philadelphia suburb, owes its origin to Dr. Joseph W. Taylor, a Quaker, who founded it in 1885. Not the largest of schools, it is nevertheless one of the finest educational institutions in America, and has many foreign students. The young women in cap and gown, seen above, are marching toward Goodheart Hall to receive their degrees at commencement.

education. Although in most of these states school attendance had been compulsory between the ages of 6 and 16 not half the children who were enrolled in the first grade progressed beyond the sixth. This was due chiefly to the fact that many found it impossible to complete the work of each grade in one year and, failing of "promotion," were held back as "repeaters." Most of the repeaters left school as soon as the law permitted. In the first decade of the century this problem of "retardation" and early "elimination" was recognized and various steps were taken to solve it. Methods of teaching were improved; in the larger towns and cities special classes were organized for the slower learners; special types of work, such as manual training and the household arts, were introduced; and school systems began to vie with each other in offering special opportunities and retaining the largest possible number of pupils on into high school.

An Amazing Record of Achievement

The high schools continued the remarkable growth that began about 1890. The arbitrary programs of the older type of secondary education were expanded to include many "practical" courses, such as stenography, typewriting, bookkeeping, woodwork and machine shop practise, the household arts, and, in the farming districts, agriculture. Cultural studies, too, were added. Outside reading and research were stressed. These changes, together with the efforts to prevent elimination in the lower grades, brought into the high schools increasing numbers of pupils. The enrolment for the country as a whole jumped from 200,000 in 1890 to nearly 1,000,000 in 1910, and in 1931 the enrolment was more than 5,000,000. In the latter year, in more than one state and in several of the larger cities, secondary education was as nearly general as elementary education had been a generation back.

Following closely the growth of high-school enrolment came a corresponding increase in the number of students attending colleges, universities, and other institutions of higher education. This was particularly marked in the third decade of the century and the enrolment in these institutions increased beyond the high-school enrolment 20 years before. It has been estimated that in the United States more persons above the age of 14 are in regular full-time attendance at school and college than in institutions of the same grade in all other countries combined.

All this represents an upward expansion of mass education that is without a precedent in the history of education. What this expansion may mean to the future of the United States it would be difficult to conjecture. But one thing is certain: The next generation of Americans will be easily the most generously schooled generation the world has ever known.

Bewildering Array of Subjects

This remarkable growth in school enrolment was accompanied by a great many new and important developments within the institutions. The multiplication of offerings in the higher institutions is almost bewildering. There is scarcely any field of human endeavor above the purely routine levels which is not provided for by college or university courses. In 1900 the professional schools connected with the universities were largely limited to theology, law, medicine, pharmacy, dentistry, and engineering, although in the preceding decade a few of the universities had

established schools of education or teachers colleges. Schools of the last-named type multiplied very rapidly between 1900 and 1920. Schools of journalism, schools of commerce and business administration, schools of music and of art came in quick succession. Of highly specialized courses there appears to be no end. One can study in college today the problems of the police and the detection of crime; the operation of hotels; the management of hospitals; the special problems involved in the manufacture of textiles, pottery, and furniture; the making of books; the building of ships; the writing of advertisements.

Highly important has been the university study of the problems involved in education itself. In fact, the development of the science of education has been almost entirely an American achievement. The recognition of the extent to which children were retarded in school led to a study of individual differences in mental ability or capacity to learn. New terms coined by the students of mental measurements came very quickly into common use:—the "I. Q.," "mental age," "moron," and the like. (*See* Individual Differences; Intelligence Tests; Mental Deficiency.)

A parallel development concerned itself with the measurement of the actual results of teaching and learning the various school subjects. This movement was initiated by Edward L. Thorndike, who devised in 1909 a scale for measuring handwriting. Similar measurements were soon worked out for arithmetic, spelling, and other subjects in the elementary and secondary schools.

Recent Changes in Method of Instruction

Other important developments had to do with the selection and organization of materials for teaching and learning and with improvements in the methods of teaching. There was still much criticism of the formalism and "bookishness" of school education, and numerous efforts were made, especially in the elementary schools, to relieve the formalism and to make the processes of learning conform more closely with the needs and interests of the learner. The formal type of recitation in which pupils were called upon in turn to restate what they had all learned from a single textbook was supplemented and sometimes replaced by the "socialized recitation" in which different pupils told their fellows what they had learned from different texts or reference books.

The "project" or "problem-project" method, developed by William H. Kilpatrick on the basis of the educational theories of John Dewey, involved a much more fundamental change. It represented an effort to bring to the learner the knowledge and skill that he should master by interesting him in some large problem. The theory thus reflected the guiding principle laid down by Rousseau in the education of Émile—that lessons should be learned when the learner feels a need for them. A group of children is interested, let us say, in building a playhouse. This may become an educational project if it reveals to them a need for mastering some of the elements of arithmetic, reading, writing, and spelling in order to carry their project through to a successful conclusion. Some students of education believe it is possible to organize around a series of projects all that pupils need to know regarding the several school subjects. Thus they would do away with the systematic mastery of the separate subjects, such as arithmetic, geography, history, and the like; they would teach every fact and principle that it is essential to know and would develop every essential skill in connection with real problems that appeal to the pupil as worth his time and effort to solve. The educational doctrines reflected in the project method are basic to the so-called "Progressive" school of educational theory.

The Dalton and Winnetka Plans

Another interesting development during the period under consideration was the emphasis given to individual instruction under the Dalton and Winnetka plans. Up to the middle of the 19th century, elementary instruction was almost exclusively individual; that is, the master sat at his desk and had the pupils come to him one by one to recite their lessons or present the solutions of their arithmetic "examples."

Class instruction became general during the latter half of the 19th century. This has certain advantages, but it also has serious defects, the most important of which is that it tends to neglect individual differences and to assume that all children can progress at the same rate. These tendencies gave rise to a condition often referred to as the "lock-step" in education. Various schemes were devised to correct this condition. Of these the best known and probably the most successful are the two plans discussed here.

The Dalton plan first developed by Helen Parkhurst in the schools of Dalton, Mass., organizes school work beyond the fourth grade into learning units. Each unit constitutes, so to speak, a "job" which the pupil "contracts" to do. He may go at his own rate, for each step that the learner is to take is clearly indicated. As each unit is completed it is presented to the teacher for approval, and if approved, another unit is "contracted" for.

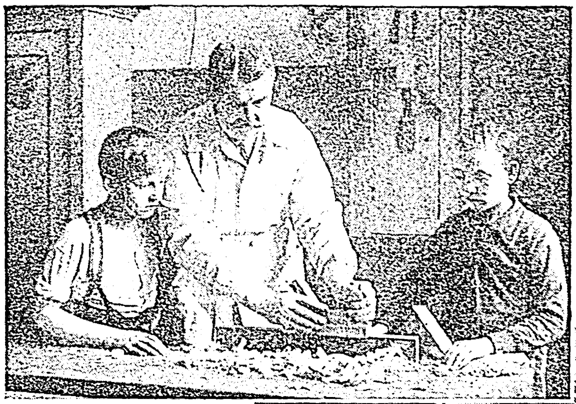
The Winnetka plan is similar in principle to the Dalton plan, but certain subjects—especially the social studies—are taught by group instruction rather than by individual instruction. The Winnetka plan also makes large use of measuring devices by means of which the pupils may know how fast they are progressing. This plan takes its name from the schools of Winnetka, Ill., where it was developed under the leadership of Carleton W. Washburne.

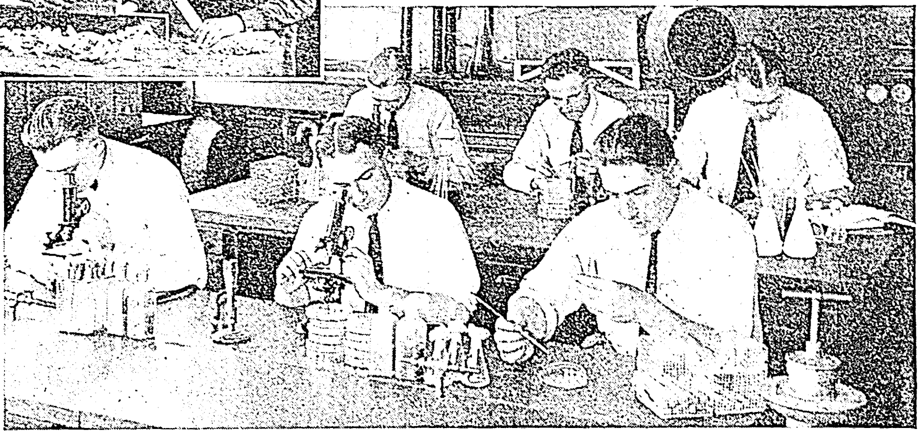
Attention to Mental and Physical Health

In 1900, the school nurse, the school dentist, and the school physician were practically unknown; by 1930, every large school system had its medical, dental, and nursing staffs, and many systems employed in addition psychologists and specialists in mental health (*see* Mental Hygiene). No other phase of educational endeavor made greater progress during this period than that which concerns the health of students.

Lavish sums were spent in the construction, equipment, and adornment of school buildings. City high schools today are generally housed in buildings notable not only for their size but for their architectural excellence. Elementary schools as well as high schools usually have auditoriums, libraries, and gymnasiums. Building programs were planned on a scientific basis, which took account of the probable trends in the growth of residential sections so that far in advance of the actual opening of new sections school sites could be acquired and ample space for playgrounds insured.

EDUCATION IN THE PRACTICAL MODERN AGE





Boys at work with carpenter's tools and with microscopes represent a very different idea of education from the old one of constant study of the past, its languages, its history, its beliefs. We, like the ancient Greeks, believe that education must also have an eye to the future. Boys in Germany, shown above, enjoy manual training as do young Americans. Below, the students at Purdue University, Lafayette, Ind., are absorbed in the important study of bacteriology.

The Junior High School

In the second decade of the century, the junior high school movement was initiated. The period of elementary schooling before this development covered eight years in most of the Northern states, seven years in most of the Southern states, and nine years in New England and northern New York. Taking the country as a whole, the eight-year elementary school was most common. Many educators believed that the transition from the elementary school to the high school would be more readily and economically effected if an intermediate organization were developed to include the ninth grade of the high school and the seventh and eighth grades of the elementary school (in the South, the seventh grade of the elementary school). The term, "junior high school," was the usual designation of this unit, although in some of the Western states the preferred name is now "intermediate school." An important function of this new unit, according to the purpose of those chiefly responsible for its development, is vocational guidance; that is, the junior high school should offer a variety of courses which would test the pupil's fitness for different occupations (*see* Vocational Guidance). In actual practise, the development of the junior high school resulted in the construction and equipment of many fine buildings with but few changes in the program of studies. The chief practical effect was to extend the period of elementary education from eight (in the South seven) years to nine (in the South eight) years, and thus to approximate the standard of nine years of elementary education which had been set by the New England states in the latter part of the preceding century.

Advances in Teacher Training

Throughout these 30 years of unprecedented growth in enrolment, buildings, and equipment, American education was seriously handicapped by the meager qualifications of many teachers. An investigation by Lotus D. Coffman, the report of which was published in 1911, justified the following conclusions relative to the situation in the country as a whole:

1. More than half of the public school teachers were under 25 years of age, and nearly one-fourth had not reached the age of 21. Millions of boys and girls were being prepared for the responsibilities of citizenship by teachers who were not themselves old enough to vote.
2. Teachers served on the average not longer than four years, and tens of thousands left at the end of one or two years. Millions of boys and girls spent their few years of schooling under a succession of immature novices in the difficult art of teaching.
3. Although every state supported one or more normal schools for the training especially of elementary school teachers, scarcely one in five of the elementary school teachers throughout the country was a graduate of these tax-supported professional schools. Tens of thousands of boys and girls received all of their schooling under teachers who had progressed no further than the eighth grade.

Conditions, of course, varied widely among the states. In New England, and especially in Massachusetts, Rhode Island, and Connecticut, well-trained teachers were the rule rather than the exception. This was generally true, too, of the larger cities; but in the small town and the rural schools, the vast majority of the teachers were immature, wholly untrained or

seriously undertrained, and transient in the service. In typical rural counties of so prosperous a state as Illinois, more than half of the teachers employed in a given year were often beginners.

Among the nations that had embraced the ideal of universal elementary education, the United States stood almost at the foot of the list in respect to the qualifications that it demanded of teachers in the elementary school. The explanation is to be found in part in the almost purely local control of education throughout the United States. The Federal government has nothing to do with the direction of education in the several states; the state governments, while legally qualified to exert any measure of direct control, followed in the main the American tradition of emphasizing local responsibility and delegated most of their powers to local communities. It is true that the states enacted compulsory schooling laws, passed laws in some cases requiring certain subjects to be taught in every school, and prescribed in most instances the minimum qualifications for the licensing or certification of teachers. These qualifications, however, were almost always low enough to permit any community to employ teachers who could pass a simple examination in the usual elementary school subjects.

Under these conditions, it was inevitable that appointments to teaching positions should go first to residents of the local community and to girls or young women who could live at home, for thus the salaries—which as a rule the local community paid through local taxation—could be kept at a minimum.

Teaching as a "Stop-Gap"

An important factor which particularly influenced the brief service of the teacher in the lower schools was the tradition that teaching, while a fairly honorable means of earning a living for a short time, was scarcely to be looked upon as a life career. Many able young men entered the work in order to earn money to meet their college expenses or to prepare for a "real" profession, such as medicine or law. After the Civil War, during which women replaced men very largely as teachers in the lower schools, teaching was looked upon as a convenient stop-gap between a girl's own schooling and her marriage. Even today in many parts of the country married women are barred from teaching.

Determined efforts to correct the weaknesses inevitable in an immature, undertrained, and transient teaching personnel followed the publication of Coffman's report. The normal schools strengthened their courses and attempted to attract a larger number of students who would make a serious preparation for teaching. Many of these schools had advanced from the secondary to the collegiate level—that is, they required high-school graduation for admission, whereas formerly they had as a rule taken students from the eighth grade and provided for them a combination of high-school work and professional training. This movement spread rapidly from 1910 to 1920. With the advance to the collegiate level, some of the normal schools changed their name to teachers college—a tendency that spread rapidly until now the term "normal school" is rarely used.

Many state governments advanced the standards for the certification of teachers and made it advantageous for the prospective teacher to take training in a professional school rather than to qualify for an appointment by passing a licensing examination. More important was a gradual extension of the policy of granting state aid to the local school districts so that poor communities might have better trained teachers.

World War Causes Teacher Shortage

These and other developments received a serious setback when the United States entered the first World War. Many of the men were drawn into the military service and the imperative demand for workers in other fields caused a serious shortage of women teachers. Enrolment in professional schools fell off.

For more than five years after the war, the shortage of trained teachers continued. During these years and during the war itself, however, there had been a substantial advance in teachers' salaries, and financially the work of teaching was much more attractive than ever before. The growth of the high schools had not been seriously affected by the war, and each year larger and larger classes were graduated. Many of the graduates entered the colleges and universities, and these institutions had great difficulty in finding quarters and instructors for the students who flocked to them in ever-increasing numbers. The teachers colleges and normal schools shared in this growth. By 1925, the output of trained teachers from the colleges and professional schools was more than ample for the schools that could and would employ such teachers.

With a surplus of trained teachers, the time was opportune for the training institutions again to advance their standards. Early in the third decade, the New York normal schools added a third year to the former two years of study. A few other states and several of the large cities soon followed New York's example. Certain states and cities even added a fourth year, and in this way made the equivalent of college graduation the minimum educational qualification.

With lengthened training and increased financial rewards, a much larger proportion of those entering the profession came to regard it as a permanent calling. The growth of the professional spirit and pride in the calling is evidenced by the fact that the National Education Association increased its active membership from 10,000 in 1918 to more than 200,000 in 1930, and by the latter year the state professional organizations enrolled nearly three-fourths of the nation's teachers.

This was far from the situation of 20 years before. From its place near the foot of the scale among civilized nations in regard to the training provided for its public school teachers, the United States had advanced to a place close to the top.

Changes in European Systems

This does not mean, however, that other nations had been standing still educationally. With the over-

throw of monarchies and the establishment of republics in Europe, sweeping changes were made in the educational systems in the direction of wider opportunities for the masses. In most European countries, there was, before the war, a sharp division between the elementary and the secondary schools. The former were for the children of the masses. They insured almost universal literacy; yet their programs were narrow, and those who completed the eight years of school work were not thereby qualified to enter the secondary schools. The latter were essentially schools for the upper classes, and those who entered them did so early in their school life and underwent a course of training quite different from that provided in the elementary schools. The reforms that were made after the war looked in general toward a democratic system of education which would be open to all, irrespective of rank or wealth.

Education in Soviet Russia

By far the most interesting and perhaps the most significant educational development in Europe following the first World War was in the Soviet Union. The imperial government of old Russia had neglected almost entirely the elementary education of the masses, although excellent secondary schools and well-equipped universities were provided for the privileged classes. At the time of the first Russian revolution, upward of 80 per cent of the Russian people were illiterate—a fact which made anything in the nature of an effective democracy out of the question. The Communist leaders who later seized and retained control of the government recognized this fact, and among their early projects was the speedy development of an effective educational system. Schools were opened, especially in the cities, as rapidly as quarters could be provided and teachers trained. In 1928 the expansion of the educational program and the "liquidation" of illiteracy became important elements in the famous Five-Year Plans. Soviet education, however, was not to follow the pattern set by the "capitalistic" nations. A primary aim was to insure unswerving loyalty to and enthusiasm for communistic ideals and institutions. Respect for manual labor was also to be emphasized, and work and study were to go hand in hand. The first efforts to build a flexible and progressive curriculum were soon replaced by a strict regimentation of studies and activities.

Adult Education

The movement to offer special educational privileges to adults is widespread, and many types of instruction are given in continuation schools, night schools, and by correspondence. Courses include citizenship training for the foreign born; parent education; public school education of elementary and high-school grade; vocational training; and college and university courses. The work is sponsored and organized by state departments of public instruction, local school boards, civic bodies, fraternal societies, and welfare organizations; and by private schools, colleges, universities, and foundations. In the 1930's the Federal government undertook adult education as part of its relief program through such agencies as the WPA and the CCC. Where adult education is organized on definite scholastic requirements, it is usually accredited for diplomas and degrees.

—REFERENCE-OUTLINE *for Organized Study of* EDUCATION—

EDUCATION weaves the fabric that binds the rising generations with those that have gone before. Thus it holds steady and unbroken the course of civilization. Its aims and methods are shaped by past experience and help in turn to shape future enterprise. This outline surveys education from both aspects—first, as a part of history; second, as an applied social science.

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The LONG LINE *of* ENGLISH EDWARDS

Their Story Covers More than a Thousand Years of History, from Edward the Elder, the Worthy Son of the Great Alfred, to Edward VIII, the Democratic 20th-Century Sovereign

EDWARD, KINGS OF ENGLAND. Eight English sovereigns have borne the name Edward since the Norman Conquest and three before that event.

Of the earlier or Anglo-Saxon Edwards, EDWARD THE ELDER (ruled 899–925) was the capable son of Alfred the Great and distinguished himself by reconquering from the Danes a large part of England which at Alfred's death still remained in their hands. EDWARD THE MARTYR (ruled 975–979) belongs to the decline of Alfred's line and was murdered at his stepmother's instigation in order to bring her son Ethelred the Unready (979–1016) to the throne.

EDWARD THE CONFESSOR (ruled 1042–1066) was the son of this unhappy Ethelred. His election to the throne of England after the death of Hardicanute marked the end of Danish supremacy. He was noted alike for his weakness as a ruler and his piety as a man. His greatest legacy to his people was Westminster Abbey.

EDWARD I (ruled 1272–1307) belongs to the offshoot of the Norman line which we call the Plantagenet house and which came to the throne in the person of his great-grandfather Henry II. He was one of the greatest rulers that England ever produced. In the Barons' Wars of his father's (Henry III's) troubled reign, Prince Edward learned much both of politics and of warfare. For a time he was closely associated with Earl Simon de Montfort, the popular leader of the National party. Later he opposed Simon and defeated him in the battle of Evesham (1265), in which the great earl was slain. Edward further enriched his experience by going on a crusade to the Holy Land in 1270.

Becoming king at the age of 33, Edward accomplished three things of great importance. He united Wales and England (1284) by conquest; and from his reign dates the use of the title "Prince of Wales" for the heir to the British throne. Secondly, Edward helped on the development of Parliament and of constitutional government, by calling the "Model Parliament" of 1295, by issuing his "Confirmation of the Charters" (1297), and by distinctly recognizing the principle that no new or extraordinary taxes should be levied without the consent of Parliament. Of equal

importance was his reorganization of the laws of England, which won for him the name "the English Justinian"; and by the close of his reign both the English system of law and courts and the English constitution were fully developed.

The care of his French possessions, now limited to Aquitaine, absorbed much of Edward's attention. His chief failure grew out of his effort to unite Scotland with England—an attempt checked by Wallace at Stirling in 1297, and again later by Robert Bruce.

THE KING WHO BUILT THE GREAT ABBEY

Edward the Confessor was a good king, gentle, rosy-faced, and with white hair and beard—a most fatherly looking father of his people, although incapable of the firmness which his kingly office required. He was a man of strong religious sentiments, and one of his chief delights was in building churches. The most beautiful of these was the famous Westminster Abbey, which in its original form was built for him by Norman architects. His early years were spent in exile in Normandy, and the favor he showed to Normans paved the way for the Norman Conquest.

Edward I was a fine looking man, with fair hair and ruddy cheeks. He was so tall that he was nicknamed "Longshanks," but he was well knit and athletic. He delighted in tournaments, and his bravery and presence of mind were well shown in the Holy Land when an assassin tried to stab him with a poisoned dagger. He prided himself on his truthfulness, and adopted as his motto "keep faith" (*pactum serva*). All in all, he was one of the greatest of England's kings.

EDWARD II (ruled 1307–1327) was the unworthy son of Edward I. He had the tall stature and fine appearance of his father, but mentally and morally he was a degenerate, and was constantly under the influence of some designing favorite. He was a coward in battle, and in spite of his father's careful training had no aptitude for business. With such a man on the throne it is easy to see why the reign was one of disorder and disaster. Yet one benefit resulted, illustrating what the historian Freeman calls "the temporary evil but lasting good of a bad king." Things grew so bad that in the end Edward was forced to give up the throne, and Parliament's control over the crown was thus strengthened. First the barons forced the king to dismiss Piers Gaveston, his earliest favorite. When Gaveston returned he was put to death (1312). The defeat of the English forces by Bruce at Bannockburn (1314) compelled Edward to recognize the independence of Scotland. In 1326 Edward's enemies, led by his French queen Isabella, her lover Roger Mortimer, and her brother the French king, planned a widespread revolt. Isabella and her followers easily captured the king, while his two new favorites, Hugh le Despenser and his son, were seized and hanged. Then in January 1327 Parliament declared Edward II deposed and set in his place his young son Edward III. Eight months later the deposed king was brutally murdered by Mortimer.

EDWARD III (ruled 1327–1377) was 15 when his father was overthrown and he himself made king. In 1330 he seized the unscrupulous Mortimer and put him to death, and sent away his mother. With this act he became the real ruler.

Edward III proved himself a chivalrous knight rather than a great king. He gained temporary glory but no lasting profit through prolonged fighting in Scotland and in France, where his name is associated with the first part of the Hundred Years' War (*see* Hundred Years' War). The chief results of his reign were internal. The English people became more conscious of themselves as a nation distinct from the French. There was increased use of English in the government and in the literature of the day. The war also compelled the king to summon Parliament frequently in order to secure from it money to meet

his great expenses, and as a consequence it grew in importance. (*See* Parliament.) During Edward's reign a terrible plague known as the "Black Death" wiped out from one-third to one-half of the country's population, and caused great social and economic changes, whose effects lasted for centuries after the worn-out Edward III was in his grave.

EDWARD IV (ruled 1461–1483), the first of the Yorkist kings, grew up in the midst of the struggles between the two great houses of York and Lancaster which produced the Wars of the Roses. He became Duke of York and leader of the Yorkist party, through the death of his father at the battle of Wakefield (1460).

Edward triumphed over the Lancastrian Henry VI and secured the throne largely through the support of his powerful cousin the Earl of Warwick, later called the "Kingmaker." But Edward soon offended Warwick by marrying against the latter's wishes and by placing his wife's relatives in positions of influence at court. Warwick finally went over to the side of the Lancastrians; and though he for a time forced Edward to abandon England and take refuge in Holland (1470), in the end Edward proved himself more than a match for his enemies. He returned to England, defeated and killed Warwick in battle, and re-established himself on the throne. Edward won back for the kingship much of the absolute power lost to Parliament by the Lancastrian kings who had preceded him, and did much to restore the country to a settled condition. He is described as the handsomest prince in Europe, jovial and familiar with all sorts of people; but he was capable of great ferocity and was lacking in moral sense.

THREE SAILOR KINGS

This photograph taken in 1905 aboard a royal yacht shows the wise and genial King Edward VII, with his son who became George V, and his grandson who became Edward VIII.

EDWARD V was the son of Edward IV, and was nominally king from April to June, 1483. His cruel uncle Richard of Gloucester managed to get himself appointed Protector of the kingdom, and soon the little king and his young brother were shut up in the Tower of London and disappeared. There is little doubt that they were murdered by order of their uncle, who had himself crowned king as Richard III. Nearly 200 years later some bones of two children were found buried in an old chest in the Tower.

EDWARD VI (ruled 1547–1553) belonged to the house of Tudor, which came to the throne on the fall of Richard III in 1485. He was the son of King Henry VIII by his third queen Jane Seymour, and became king at the age of ten years. First his mother's brother, the Duke of Somerset, and then the Duke of Northumberland controlled the government. Great things were expected of the young king, but he died of consumption in 1553 at the age of 16.

EDWARD VII (ruled 1901–1910) was born in 1841, four years after his mother, Queen Victoria, came to the throne. Sixty years passed before he succeeded her as the first of the House of Saxe-Coburg-Gotha (*see* Hanover). Emperor William II of Germany and Czar Nicholas II of Russia were his nephews; he was closely related to most of the other European rulers; and in 1863 he married Princess Alexandra of Denmark. These connections gave him an insight into world diplomacy. He played an influential part in bringing Great Britain, France, and Russia together in 1907 into the Triple Entente—the alliance which, at the beginning of the first World War, aligned these nations against Germany and Austria.

EDWARD VIII (ruled Jan. 20 to Dec. 11, 1936) became king at the death of his father, George V, and abdicated 326 days later, when the government opposed his determination to marry Mrs. Wallis Warfield Simpson, an American woman. His voluntary abdication was without precedent in British history, and his decision to give up the throne rather than the woman he loved stirred and divided popular feeling throughout the world.

Born in 1894, Edward was christened Edward Albert Christian George Andrew Patrick David. In 1911, shortly after his father was crowned king, he became Prince of Wales. The outbreak of the first World War cut short his studies at Oxford and he joined the army. After the war Edward traveled as an emissary of good will for his empire, stimulating everywhere kindly feelings and improved trade relations. With his father's death on Jan. 20, 1936, Edward became England's first bachelor king since George III.

Edward's democratic, frank, and unconventional personality, his independent character and his informal behavior did not fit easily into the rigidly formal rôle imposed upon the British crown by tradition. Soon after ascending the throne, he announced publicly his intention of marrying the twice-divorced Mrs. Simpson. This open defiance of precedent disturbed political leaders. Parliament was solid against the marriage; so was the press—although Edward was cheered enthusiastically by the crowds in London and elsewhere and, generally, was even more popular than before. The charge was made that a "ruling clique" was making the marriage issue a means to discredit a king too popular with the masses. His supporters advised him to dismiss Parliament and force a new popular election. But Edward was unwilling to plunge the empire into a political crisis. On Dec. 11, 1936, he abdicated, and his brother, Albert, Duke of York, became king as George VI (*see* George, Kings of England).

Edward received the title Duke of Windsor. He and Mrs. Simpson were married in France on June 3, 1937. After the outbreak of war between Great Britain and Germany in 1939, he served in the British army as a major general. In July 1940 he was appointed governor and commander in chief of the Bahamas.

EEL. The common fresh-water eel—the fish that "looks like a snake"—is the hero of one of the most extraordinary dramas of mystery and adventure that the detectives of science have ever solved. It spends most of its life in the mud of streams and ponds; but until a few years ago no one knew where it came from or where it went to die. Men knew that, at certain seasons, swarms of young eels appeared in the rivers as if by magic; and they had seen the grown eels swimming downstream to disappear into the sea. What happened before and after was a blank.

The Greek philosopher Aristotle, who was called the "father of science" because of his keen observations, made a helpless guess that young eels sprouted from the mud itself. Two thousand years later, Izaak Walton reported in 'The Compleat Angler' an even wilder theory, that horsehairs in water turned into eels.

The first clue to the mystery was the discovery of the *Leptocephali*, about 150 years ago, in the waters of the Atlantic and the Mediterranean. These are creatures with tiny heads and ribbon-like bodies, transparent as glass. They were long supposed to be a kind of fish new to science. But during the latter half of the 19th century several experimenters found that *Leptocephali*, kept in aquariums, turned into young eels.

With this fact to help him, a young Danish scientist, Johannes Schmidt, began in 1905 to track down the secrets of the eel. Before his death in 1933 Professor Schmidt had made six cruises, covering more than 40,000 miles, and had dredged up from the ocean depths the answer to the puzzle. William Beebe's deep-water explorations corroborated Schmidt's findings.

Life Story of the Eel

The story is easier to follow if we begin in the middle with the more familiar facts. Let us watch a full-grown eel that has been living in the headwaters of a stream in the Eastern states. It is a female, for there are no males in these waters. As fall approaches, she puts on an extra layer of fat and then stops eating; her yellowish-brown skin takes on a silvery color; her snout gets sharper and her eyes grow large and bulging. Presently she starts toward the sea, and finds herself in company with other females that have become "silver eels" like herself. Near the mouth of the river, where the water begins to be salty, the smaller male eels appear, also in silver uniform, and join the migration. Out into the Atlantic they swim, gradually going deeper and deeper. At last they reach the warm waters of the Sargasso Sea in a tract south of Bermuda and about 900 miles east of the American coast. There in the blackness, 3,000 feet down, the females lay their millions of eggs and the males fertilize them. Then the grown eels die.

Within a few days the glass-like baby eels, or larvae, a quarter of an inch long, hatch from the eggs. Each larva carries a tiny drop of oil, which floats it upward toward food and sunshine. At first it simply drifts, feeding with needle-sharp teeth on the microscopic life at the surface. Then it begins to grow and to swim slowly toward the land. A year later, when it nears the American coast, the eel larva is about three inches long. This is what used to be called a *Leptocephalus*. Presently it begins to shrink. The high, thin body shortens, turns pink and becomes round—much the shape and size of a common wooden match. The larva has turned into an *elver*, or young eel, ready to begin its inland life.

Fresh-Water Life Begins

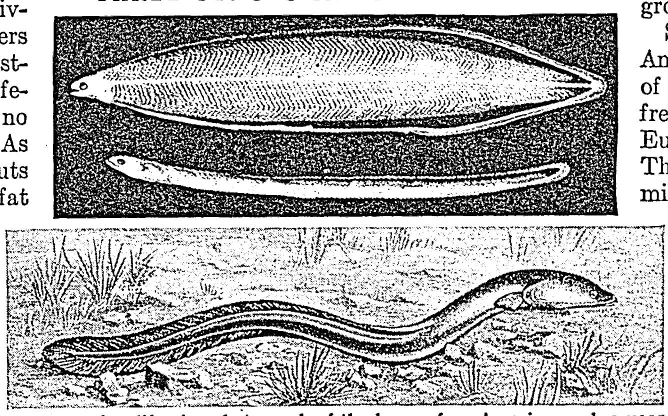
Thousands of elvers swim into the rivers on the Atlantic coast early every spring. The males remain in the brackish tidewater; but the females swim far up and may make their homes in the smallest creeks. On wet nights they have been known to leave the running water and wriggle overland to isolated lakes or stagnant pools.

The stay of the eels in inland waters ranges from 4 to 6 years for the males, and from 7 to 8 years for the females. They eat voraciously anything live or dead that they can swallow. In winter they hibernate in the mud. At maturity the females are usually from 2 to 3 feet long, the males about two-thirds as large. Occasionally a female fails to develop the breeding instinct and may live on in some fresh-water pool for 40 years or more, growing to a great size.

Side by side with the American eels in the depths of the Sargasso Sea, the fresh-water eels of western Europe come to breed. They have to travel 4,000 miles to get there. To give the larvae time to make their way back to Europe their change into elvers takes three years instead of one.

Professor Schmidt showed that similar central breeding places exist for the

THREE STAGES IN THE EEL'S LIFE



At the top is a life-size photograph of the larva of an American eel, a year after it hatched from the egg. In the second picture the larva has shrunk in size and turned into an elver. At the bottom, a grown eel is shown, about one-sixth its actual size.

eels of Africa, of Asia, and of Australia. No eels of this type are found in South America or the west coast of North America, probably because there are no ocean currents favorable to the return of eel larvae to these coasts.

The conger eels that frequent the coasts of Europe and eastern North America are strictly salt-water fish. They may grow from 4 to 6 feet long and they are much thicker than the common fresh-water eels. Some congers breed in the Sargasso Sea, some near the Azores, and some in the Mediterranean.

In warm seas live the eels called *morays*, many of which are brilliantly colored. The "muraena" so highly prized by the Romans belongs to this group.

Fresh-water eels, conger eels, and many of the morays are good to eat. The meat is nourishing and delicate when properly cooked, though some find the flesh too oily and the fine bones too difficult to remove.

Eels belong to the order *Apodes*, or "footless" fishes. Among their distinguishing features are tiny scales so deeply buried in the skin that eels are commonly thought to be scaleless. Scientific name of American fresh-water eel, *Anguilla rostrata*, of European species, *Anguilla vulgaris;* of American conger, *Conger oceanicus*, of European conger, *Conger vulgaris*, of the Roman moray, *Murena helena*. The "electric eel" of South America is not of this group, but is related to the carps and catfish (*see* Torpedo-Fish).

EGG. All animals and plants, except the most primitive types, begin life in the egg. This consists of a single female cell which is able to develop into an independent new life when it has been fertilized by a male cell (*see* Biology; Heredity). The egg cells of plants form a part of the flower and, after being fertilized, they turn into seeds (*see* Flowers; Seeds).

The Eggs of Animals

The egg cell of a mammal hatches inside the mother almost immediately after it is fertilized. Thus the early development of the young (called at this stage the "embryo") takes place *outside of the egg*—between the time of hatching and birth. The only mammals that depart from this rule are the duckbill and the spiny anteater (*see* Duckbill).

All other animals that come from eggs undergo their early development *inside the egg*. Usually the female lays the egg some time before it is ready to hatch. This is true of all birds. But the females of certain snakes, lizards, fishes, and insects keep the eggs inside their bodies until the moment of hatching, so that their young seem to be born alive like those of mammals. Animals of this type are sometimes called "viviparous" ("live-bearing"), to distinguish them from the egg-laying or "oviparous" animals.

Differences in Egg-Laying Habits

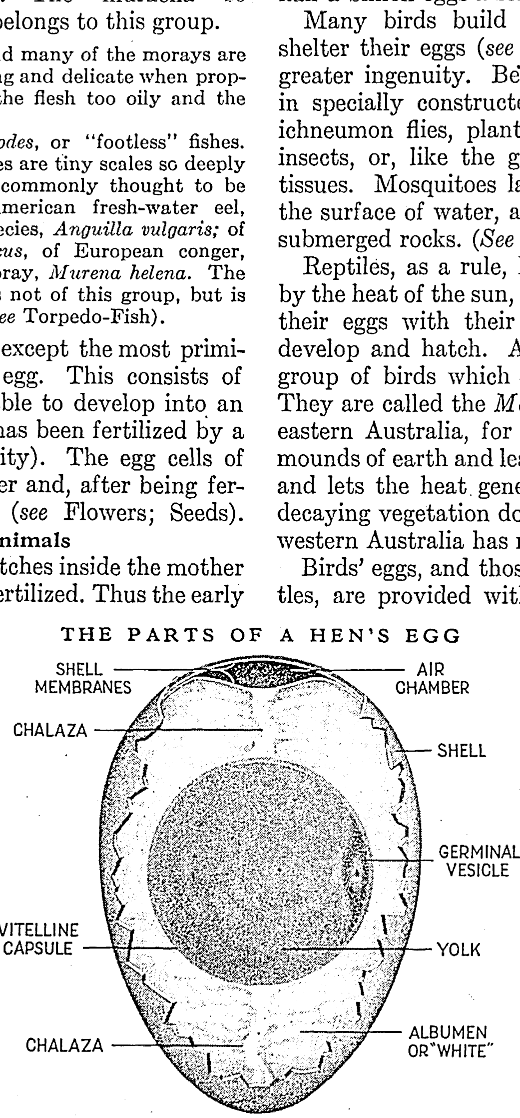
The egg-laying habits of animals depend a good deal upon the dangers to which their eggs are exposed. Thus the auks, which nest in inaccessible places, lay only one egg each season. Certain fishes, like the cod, the sturgeon, and the turbot, whose eggs are easy prey for hundreds of enemies, lay millions at a time. Oyster eggs are not only threatened by many enemies but also require specially favorable conditions for hatching, so a large oyster is likely to lay more than half a billion eggs a season.

Many birds build extremely elaborate nests to shelter their eggs (*see* Birds). Insects show an even greater ingenuity. Bees and wasps place their eggs in specially constructed wax cells; others, like the ichneumon flies, plant them in the bodies of other insects, or, like the gall-flies, imbed them in plant tissues. Mosquitoes lay their eggs in little rafts on the surface of water, and buffalo gnats glue theirs to submerged rocks. (*See* Insects.)

Reptiles, as a rule, leave their eggs to be hatched by the heat of the sun, but nearly all birds must warm their eggs with their own bodies before they will develop and hatch. Australia, however, produces a group of birds which hatch their eggs like reptiles. They are called the *Megapodes*. The brush turkey of eastern Australia, for instance, simply scratches up mounds of earth and leaves, lays its eggs in the mound and lets the heat generated by the sun and by the decaying vegetation do the work. The mallee-bird of western Australia has much the same habit.

Birds' eggs, and those of crocodiles and certain turtles, are provided with a rigid shell. But most of the reptiles have eggs covered with a tough elastic membrane, like parchment. The eggs of fish, toads, frogs, and salamanders are usually surrounded by a jelly-like substance, which often binds them together in great masses. Those of the octopus are in clusters, like berries on a stalk.

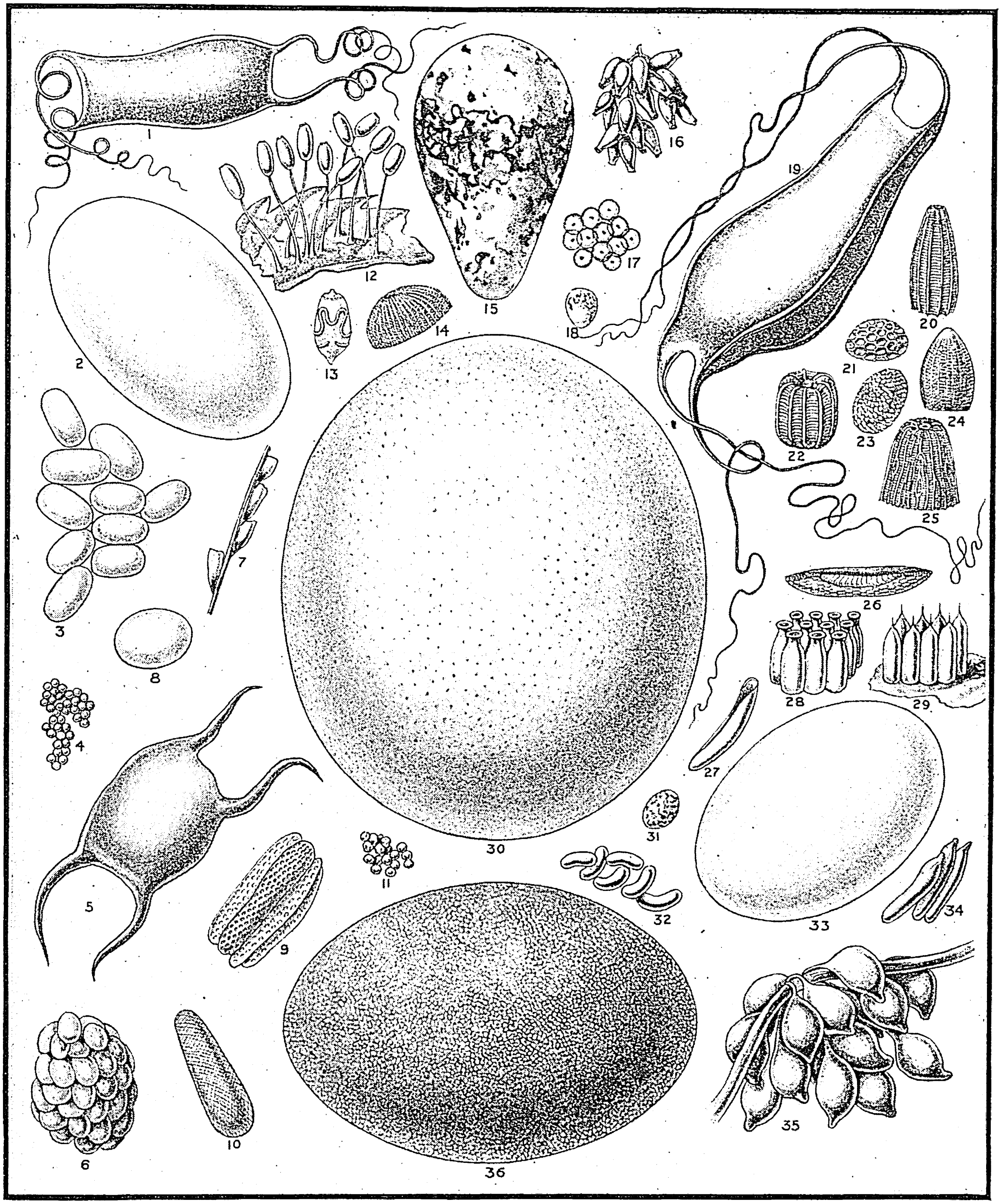
THE PARTS OF A HEN'S EGG



Inside the shell are two membranes. One of them clings to the shell, the other to the white of the egg. Between the two membranes at the blunt end is an air chamber. The chalazas are strands of denser, twisted albumen, formed by the rolling of the egg inside the hen before it is laid. They are attached to the inner shell membrane and to the vitelline capsule—the "skin" of the yolk. They hold the yolk in place. The germinal vesicle or "germ" is the living part of the egg from which the chick begins to grow. All birds' eggs are made up like this. The egg is laid blunt end first.

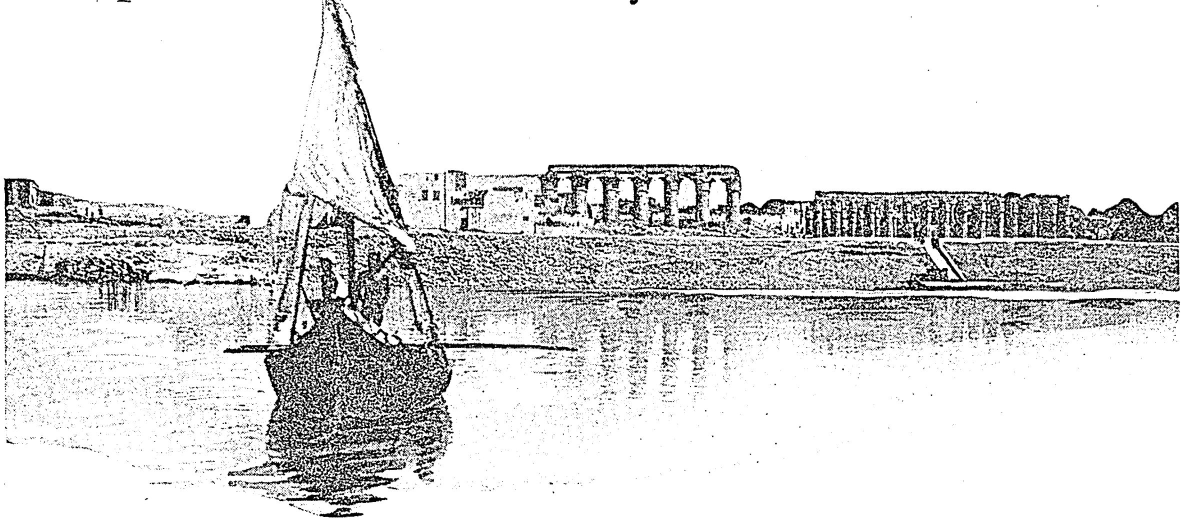
The germ from which the new life starts is usually only a part of the material inside an egg. The remainder is food for the growing embryo. It is this food supply which attracts egg-eating animals. Besides hens' eggs, men eat the eggs of ducks, geese, guinea fowls; and, in some countries, they eat the eggs of sea birds. In the tropics turtle eggs are considered a delicacy. Fish eggs, called "roe," or salted and prepared as "caviar," are prized the world over. (*See also* Cell; Embryology; Poultry.)

NATURE'S FANCIES IN THE WORLD OF EGGS



In the world of the grocer there are only three kinds of eggs, "fresh," "strictly fresh," and plain eggs. And since these are all hen's eggs, they are all of the same shape; but in the wide world outside the grocery what a wonderful variety in design! Some are oval; some have points and even tendrils; some are single, others come in clusters and still others are set up on stalks. This group of pictures shows a few distinctive types: Dog Fish (1), Crocodile (2), Grass Snake (3), Salmon (4), Skate (5), Whelk (6), Head Louse (7), Duckbill (8), House Fly (9), Flesh Fly (10), Snail (11), Lace-Wing Fly (12), Walking Stick (13), Cotton Worm Moth (14), Guillemot (sea bird) (15), Purpura (shell-fish of which crimson dye is sometimes made) (16), Frog (17), Creeper (bird) (18), Shark (19), White Butterfly (20), Copper Butterfly (21), Tortoise Shell Butterfly (22), Blue Butterfly (23), Milkweed Butterfly (24), Queen of Spain Butterfly (25), Malaria Mosquito (26), Stable Fly (27), Wheel Bug (28), Alder Fly (29), Ostrich (30), Grasshopper (31), Leaf-Cutter Bee (32), Python (33), Snake Fly (34), Cuttlefish (35), Emu (36). You must remember also that in addition to the great variety in appearance which the pictures show, there is also a much greater difference in size between many of the eggs than appears in the picture. The ostrich egg in the middle, for instance, is about six inches long and weighs nearly three pounds, while most of the insect eggs are no bigger than a pencil point.

The KINGDOM *of* FATHER NILE



Extent.—675 miles from north to south, 500 miles from east to west. Area of Egypt, about 383,000 square miles; population, about 16,000,000. Area of Anglo-Egyptian Sudan, about 1,000,000 square miles; population, about 6,500,000.

Physical Features.—The Nile, 4,000 miles long, longest river in the world except the Missouri-Mississippi; the fertile Nile valley, varying from 2 miles or less to 120 miles in width; deserts and oases; the Fayum; the delta of the Nile.

Engineering Features.—Suez Canal, 100 miles long, across Isthmus of Suez; Assuan Dam, 1⅓ miles long, 174 feet high; "barrages" at Esna, Assiut, Zifta. Railroads in Egypt, more than 3,000 miles; in Anglo-Egyptian Sudan, 1,500 miles.

Chief Cities.—Cairo (1,310,000 population), Alexandria (680,000), Port Said (125,000), Tanta (95,000), Mansurah, Fayum.

Products.—From Fayum and lower Egypt, cotton, rice, Indian corn, wheat, barley, clover; from upper Egypt, cereals and vegetables.

History.—Rise of Egyptian civilization between 5000 and 4000 B.C.; the Pyramid Age, 3000–2500 B.C.; Egypt's wide empire, 1580–1150 B.C.; Age of the Ptolemies (Greek rulers), 323–30 B.C., followed by Roman rule; since 641 A.D., Mohammedan; British occupation begun in 1882, ended in 1922.

EGYPT. "A country which is not a country but a longish strip of market garden"—this is Kipling's description of Egypt. Out of a total area of about 383,000 square miles, only 14,000 square miles—an area about equal to that of Maryland—is used for permanent habitation. This is chiefly in the Nile valley, a narrow strip of country hemmed in by the Arabian hills on the east and the Libyan Mountains on the west and varying in width from 2 to 120 miles. This fertile valley, in outline like the sacred lotus flower with the delta for the blossom, is a gift of the river. Without the Nile, which for centuries has deposited a thin coating of rich mud upon the sand, Egypt would not be different from the rest of the Sahara desert.

A Fertile Land where Rain Seldom Falls

The brilliant sun that shines out of a deep-blue sky, turning everything to colors so vivid as to make your eyes ache, is a desert sun, piercing the driest air in the world. Under its glare the fields and palm trees along the reddish brown or dull green river appear the greenest things in the world, the sand pours over the bare yellow rocks in a torrent of gold, and the rocks cast purple shadows. In Upper Egypt you will meet people who have never seen rain. At Cairo, 100 miles from the sea, there are four or five showers a year, and even on the Mediterranean coast there is only one-fifth as much rain as you will find in the driest part of England. And yet the Nile valley is everywhere productive, and the dwellers on the lower Nile count their harvests in terms of three crops a year.

The Nile valley is not only a garden. It is a museum where one sees gathered the works of the oldest civilization and of the most recent. Before the Greeks became a nation, and before the days of Troy's greatness, Egypt was the seat of a civilization already old and rich.

You may travel today quite luxuriously by sleeping car and river steamer from the mouth of the Nile to Gondokoro near its source. Along the banks you will see the best of modern irrigation works and you will still see the slender brown-skinned *fellahin* ("plowers") irrigating their land by means of the *shadoof*, a primitive well-sweep. For 100 days in the summer they must swing their leather buckets into the Nile day and night, and thence by three lifts get the water up the bank to their fields.

Along the banks of the Nile you will find the oldest monuments in the world, among them great temples, the Pyramids, and the Sphinx. You will also find there some of the greatest works of modern masonry, the Nile dams and "barrages."

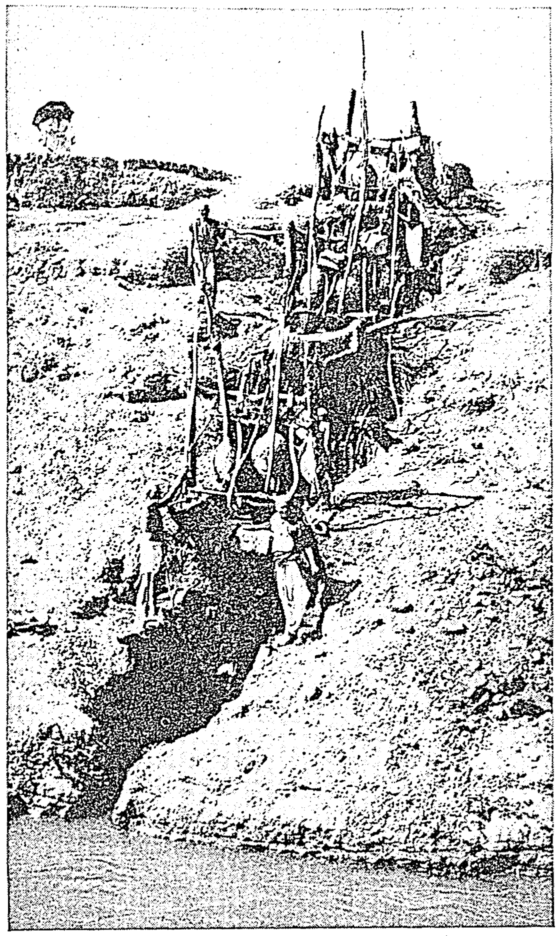
Beyond the hills that sometimes come down to the very bank, leaving but a hand-breadth of level land, lies the desert. The hilly Arabian desert on the east (not to be confused with the desert of the same name in Asia) rises in a series of steplike plateaus to lofty mountains bordering the Red Sea. Here dwell scattered groups of nomad Bedouins, and here are the remains of mines from which the ancient Egyptians

drew their wealth of gold. Here and there are dry river beds known as *wadis*. In the rare thunderstorms these carry torrents which cast bowlders about like pebbles. The wind sweeps over the desert so mercilessly that not even sand is left upon much of its rocky surface. In some districts of the Libyan desert, however, to the west of the Nile, are immense crescent-shaped sand dunes that creep onwards about 50 feet a year burying everything in their path. The Bedouin fears these "dust devils," though he knows so well how to protect himself by wrapping his head in his blanket and crouching in the lee of his camel. In the Libyan desert are five large oases made fertile by abundant supplies of underground water which rises to the surface in springs or through deep wells. Kharga, the southernmost, is reached by a railway and supports a population of 8,000 upon crops of dates, rice, and cereals.

The Fayum, one of the most fertile provinces of modern Egypt, also lies beyond the valley wall to the west. It is just south of Cairo and separated from the Nile valley by six miles of desert. The Fayum occupies a depression in the Libyan desert into which the engineers of the Pharaohs 4,000 years ago drew off the waters of the Nile in years of great flood. The Fayum today is a land of flowing streams, and abounds in oranges, peaches, pomegranates, olives, figs, and grapes, besides cotton, sugar, and the cereal crops, and is famous for its roses.

The region thus far described is chiefly Lower Egypt and the territory near it. Let us now survey the Nile country from the Sudan to Cairo coming north down the river.

ANCIENT "SHADOOFS" AND THE THIRSTY FIELDS



This picture shows a primitive method of irrigation still in use in Egypt, by which Father Nile is made to climb the stairs, so to speak, and water the thirsty fields. It consists of a group of shadoofs, which are devices much like well-sweeps, with a leather bucket at the long end and a weight at the other. Each group lifts the water one stage, until it reaches the top, where it is emptied into the irrigation ditches.

These are Egyptian water carriers filling their leather bottles from the waters of the Nile. Then they go up and down the village streets selling water for drinking and cooking.

From Lake Albert to Wady Halfa, a distance of more than 1,600 miles, we pass through the Anglo-Egyptian Sudan—a vast region of more than 1,000,000 square miles, with a population of 6,500,000, conquered between 1896 and 1899 by the joint resources of the Egyptian Khedive and Great Britain. The word Sudan means "black man's country," and the Anglo-Egyptian part of this great belt across Africa is the chief source of the world's supply of gum arabic and ivory. It produces also cotton, ostrich feathers, dom palm nuts (a sort of vegetable ivory used for buttons), dates, sesame, hides, skins, gold, and in the southern districts, rubber. The forests along the White Nile contain valuable trees, ebony, gum acacia, bamboo, and rubber creeper.

At Khartum, the scene of "Chinese" Gordon's death and of Kitchener's triumph, the White Nile meets the Blue Nile coming from Ethiopia. Across the river from Khartum is Omdurman (population, 105,000), the trading headquarters of the Anglo-Egyptian Sudan. North of Khartum is a dusty region where grow only thorny acacias. It is said that these are relished by the goat and the camel, "the goat because of his optimism and the camel because of his pessimism." Through Nubia the hills come down to the river's edge with only a fringe of land sometimes narrow

FARMING IN THE SHADOW OF THE PYRAMIDS

Do you remember how Joseph's hungry brethren went down into the land of Egypt to get "corn"—that is, what we call "wheat"? Undoubtedly the "corn" they put into their sacks to take back home was threshed in much the same way as this heap of wheat has been threshed out in the shadow of the Great Pyramid at Gizeh. The wheat is laid on the ground in a circle, and then the oxen, hauling a heavy sledge, tramp round and round, and so crush out the grain, which is winnowed by being repeatedly tossed up into the air.

enough to jump across, sometimes spreading out like a bay in the hills with clusters of palm trees.

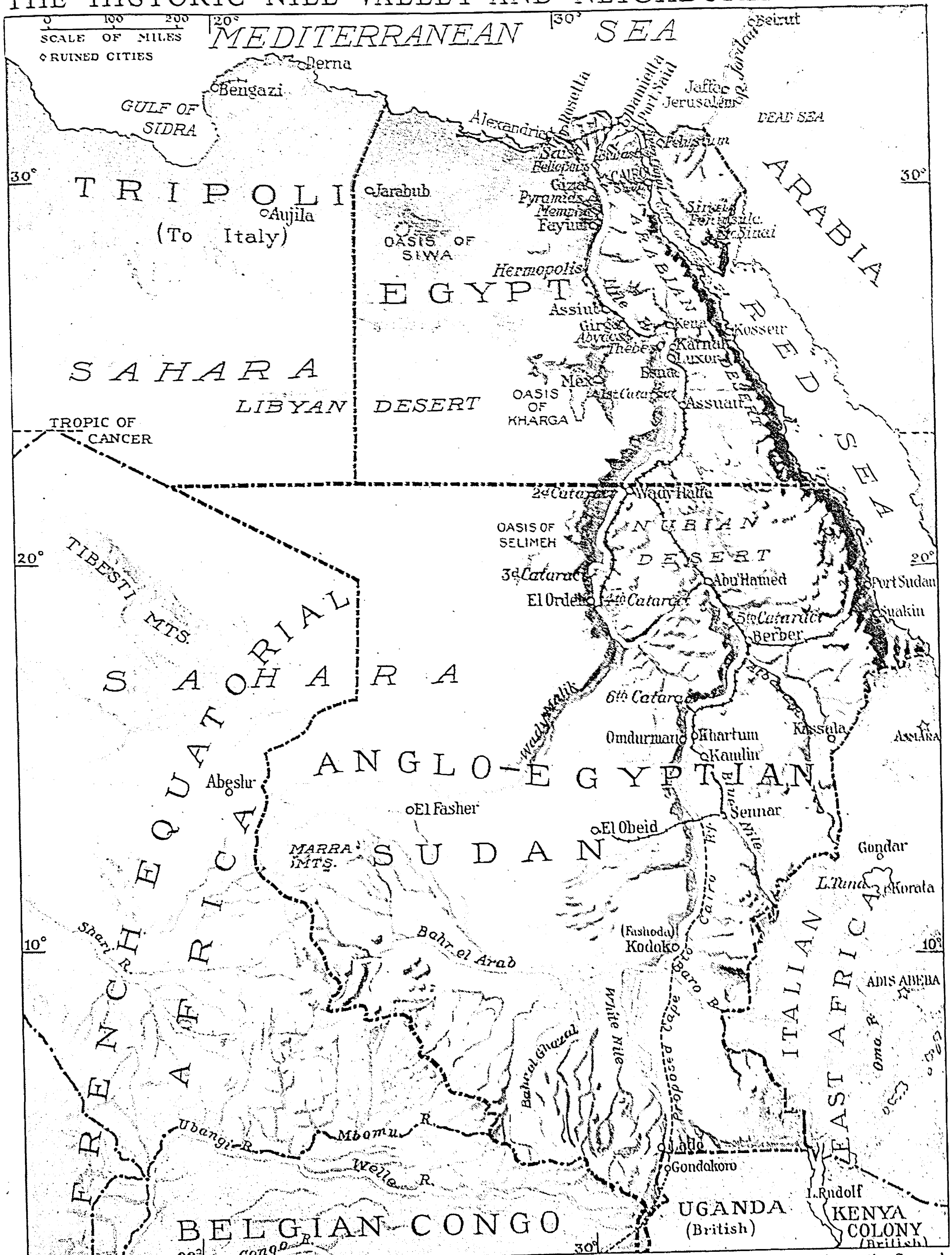
From Wady Halfa, the southern limit of Egypt proper, to Assuan is a two nights' river journey downstream, which will seem very delightful after the hot 24 hours in the train from Khartum. If you happen to be making it in February you will begin to notice strange things some time before you reach Assuan. The river widens into a lake a mile wide with rocky islands showing here and there—the tops of the temple of Philae visible on one of them—and palm trees are growing straight out of the water. This is the result of the great dam that has been built at Assuan, the first cataract, for the purpose of storing the Nile waters in flood time for use later on in the drought. The dam is over a mile and a third long, higher than most church steeples, and rivals most of the world's masonry works—even the Pyramids themselves.

At Assuan the real Nile valley begins. Limestone cliffs rising in places to 1,000 feet from the valley floor and forming a wide canyon for the river begin to open out, sometimes leaving a few yards of bank on either side of the river, sometimes 30 miles of it. A field of waving sugar cane, very green, a cluster of palms surrounding a village, a stretch of sandbanks very golden and then a glowing wall of rock—this is the scenery of upper Egypt, and its crops are onions and sugar, food and fodder. In the early summer you can smell for a long distance the onion trains on their way to Alexandria. In Upper Egypt there is usually the yearly flood crop, and any small gardening that is done in the summer must be provided with water lifted by hand or by the buffalo wheel.

At Esna is the first of the Nile barrages, a masonry structure which piles the water up, not to dam it completely but to force it through the irrigation canals and ditches and onto the fields along the riverside. Just beyond, the cliffs open out to form a wide double bay, the plain of Thebes. Here you will see temples and cliff tombs rising out of the green crops, and in the distance the Colossi of Memnon. In this region the manufacture of antiques to sell the gullible tourist is almost as much an industry as agriculture.

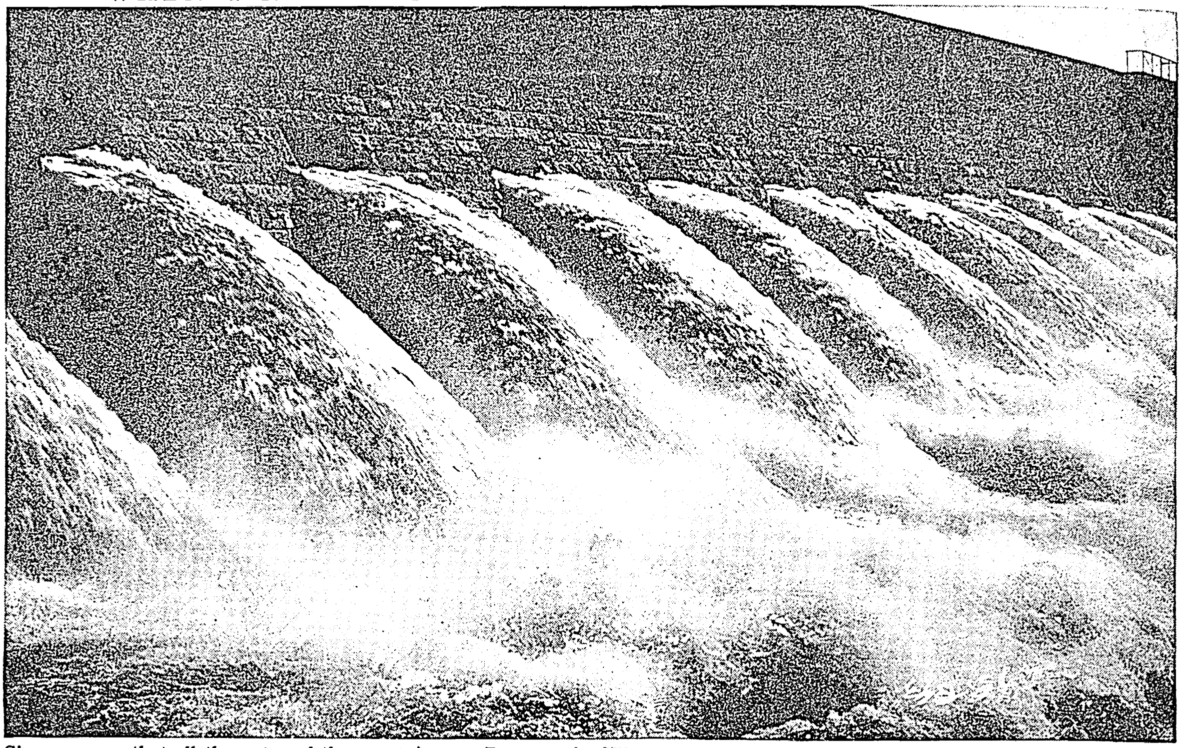
From Girga to Assiut is the Coptic center of Egypt. Here are the two great Coptic monasteries, the White and the Red, founded in Roman times. The Copts, whose name is just a corruption of the Greek "Aegyptioi," are racially the same as the other people of Egypt. They are, however, of purer descent, since they refused to intermarry with the Arab conquerors, and their language—although in disuse since the 16th century except for ritual—is descended from the ancient Egyptian. Their church is one of the earliest forms of Christianity. They have never yielded to

THE HISTORIC NILE VALLEY AND NEIGHBORING LANDS



When we say "Egypt" we usually have in mind only the "longish strip of market garden" that borders the Nile as far as the Second Cataract, though the boundaries of Egypt include an area 30 times that of the Nile valley. Note the proposed railway line across the Anglo-Egyptian Sudan which will unite the Cape of Good Hope to the Nile delta.

WHEN THE SPOUTING GATES ARE OPENED AT ASSUAN



Since we see that all the gates of the great Assuan Dam on the Nile are open, we know that this picture must have been taken some time between the first of March and the middle of November. You see, it is like this: When the river is at the highest flood, it brings down so much soil that, if the waters were stopped by the dam, the deposit would soon fill it up. After the middle of November, however, the waters are comparatively free from deposit. So at that time they close the gates and catch the clear water. Then in March they open them again and let Father Nile with his load of mud go on about his business.

Mohammedanism. The Copts, although less than one-fourteenth of the population, furnish a large proportion of the clerical and skilled labor of Egypt.

The Vivid Green of the Delta

As you approach Cairo the eastern cliffs turn sharply away to the east and the low hills of the Pyramid plateau—opposite Cairo—drop out of sight. You are suddenly in Lower Egypt or the delta of the Nile. This last hundred miles before you reach the Mediterranean is watered by 300 miles of the Nile, which here flows in two main branches emptying into the sea at Rosetta on the west and Damietta on the east. Here you will see little villages of dark mud-brick huts and groves of graceful date palms. The landscape is carpeted with vivid green, and crossed by such a network of irrigation canals that in summer little water is left to reach the Mediterranean through the natural channel of the Nile. All the larger cities of Egypt—Cairo, Alexandria, Port Said, and Tanta—are in the delta.

More than 60 per cent of the 16,000,000 inhabitants of Egypt as a whole are agricultural laborers (*fellahin*). The Egyptian government is the ultimate proprietor of the land, getting a large proportion of its revenue from the land tax. Nearly 60 per cent of the land under cultivation is in holdings of 50 acres or less, and more than 60 per cent of the landowners get their entire living from an acre or less of land. This is made possible by the fact that perennial irrigation is practiced on something more than two-thirds of the 6,000,000 cultivated acres, and thus two or three crops are obtained every year. Where the basin system of irrigation is practiced (that is, flooding at time of high Nile) only one crop can be harvested. Cereals of all kinds are sown in November and harvested in May and June. The chief crop is cotton, which is remarkable for its excellent quality. In Egypt the cotton plant yields five and sometimes six crops before replanting is necessary. The value of the crop is in some years more than $200,000,000. Wheat, corn, rice, barley, and vegetables are also extensively cultivated.

The fellahin live in close-packed villages. They do not waste their precious land for house-building, and besides they like the outer gates that can be closed at night against marauding brigands. To most of us their lives would seem to be very miserable, for not only do they work hard and live wretchedly, but they are especially afflicted by the plagues that more or less trouble everyone in Egypt—flies, fleas, and eye diseases. They seem to have become almost immune to sunstroke and so accustomed are they to their own discomforts with insects that when a pest afflicts their cotton or their animals they usually do not do anything about it until the government makes some regulation forcing them to. The wealth which their land

is yielding under the effects of scientific irrigation, and the introduction of schools is gradually but surely making their lot far less miserable.

Cotton an Important Industry

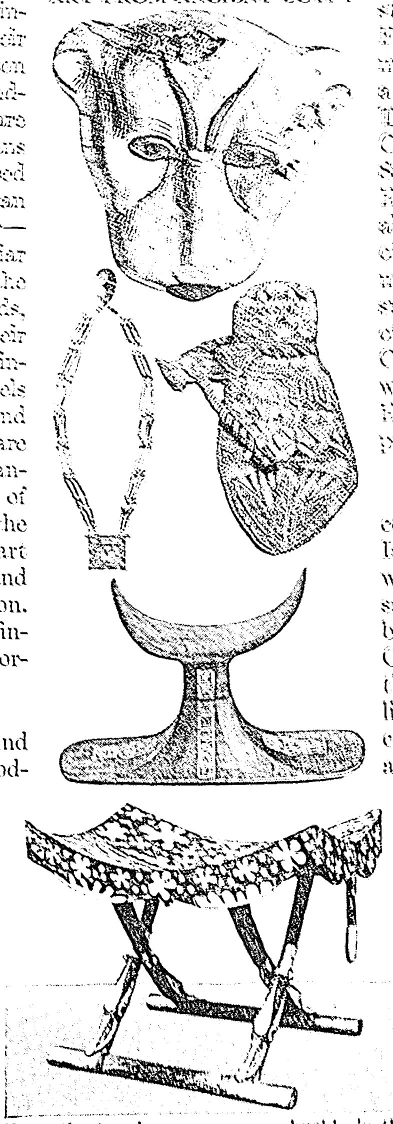
Few manufactures are carried on in Egypt, which is essentially an agricultural country; but the immense quantity of cotton that is raised gives rise to numerous mills where it is ginned and the seeds are crushed for their oil. Calico and other coarse cotton cloths are made, and Egyptian hand-woven silk shawls and draperies are often very beautiful. The Egyptians have a process of tanning practised only by themselves, and produce an excellent quality of Morocco leather—goatskin dyed and dressed in a peculiar manner. They are also noted for the making of pottery of various kinds, especially water jars; and for their ornamental woodwork, sometimes inlaid with pearl and ivory, their vessels of brass and copper, and gold and silver ornaments. Fine cigarettes are manufactured at Cairo and Alexandria, and perfumes, including attar of roses, are produced at Cairo and in the Fayum. Mills are found in every part of the country which grind maize and other grains for home consumption. Rice-milling, sugar-crushing and refining, and soap making are other important industries.

Arabian Influence in Egypt

The Arabic language and dress, and the Arabian religion of Islam in modern Egypt, are relics of the Arabian conquest of 639–41 A.D. The Arabs at first merely maintained garrisons in Egypt, with a governor to collect the taxes for the Mohammedan calif. Soon these taxes became oppressive, however, and frequent native uprisings caused the califs to install Arab colonies to protect their interests. These Arabs and the natives who professed the faith of Mohammed enjoyed many privileges denied to unbelievers: they were exempt from some taxes, and held all important public offices. The conversion of the natives to Islam was easily accomplished. Arabic became the official language of Egypt early in the 8th century.

Mohammedan wars over the succession to the throne of Islam left Egypt's governors a free hand, and in time they became practically kings, although still appointed by and paying tribute to the eastern califs. Egypt passed from the eastern to the western califate in 969, when the Fatimite (or Shiite) general Jauhar conquered Egypt for the western calif, whose claim to the throne of Mohammed was based on descent from the prophet's daughter Fatima (*see* Mohammed). The capital was moved from El-Fostat to El-Kahira ("the victorious"), the present city of Cairo (*see* Cairo). The calif was installed in a magnificent palace; and the Fatimites built the famous Azhar mosque, and ever since Cairo has been a center of Mohammedan learning. The reign of the Fatimite califs in Cairo lasted until the Kurdish general Saladin (*see* Saladin), reconquered Egypt for the orthodox or Sunnite calif about 1169, and himself became sultan of Egypt. From 1250 until the Ottoman conquest of Egypt in 1517, the sultans of Egypt came from the ranks of the Mamelukes, the Turkish and Circassian white slaves and freedmen who made up the greater part of the Egyptian army and held the most important offices.

ART FROM ANCIENT EGYPT



From the top down, you see a buckle in the form of a leopard's head; a necklace of glass and wood beads; a child's sandal of glass beadwork; a curious carved cedar head rest; and an inlaid ivory and ebony stool with duck's head legs; all from Tutenkhamon's tomb.

The Mameluke Rule

The *fellahin* of Egypt suffered almost continually in these first stages of Islamic rule. Famine and pestilence wiped out thousands. During the Crusades Egypt was the scene of fierce battles between Mohammedan and Christian forces (*see* Crusades). But in the period of Mameluke reign art and literature were encouraged, magnificent palaces and mosques were built; and public works were promoted on a grand scale.

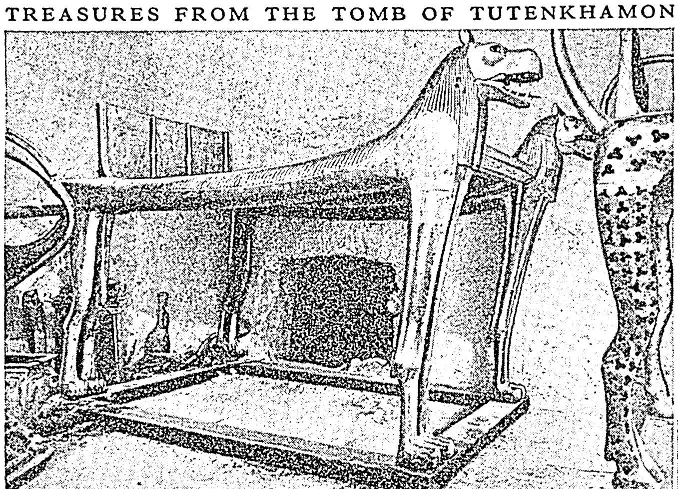
When Selim I wrested Egypt from the Mameluke sultan in 1517, he installed a *pasha* from Constantinople as Egypt's governor, but lesser officials remained. The pasha was dependent on the Mameluke *beys*, or provincial governors, for support against the native uprisings, which became more and more frequent as Ottoman power dwindled. The beys supplied the armed forces of Egypt, and it was largely a Mameluke army with Mameluke officers that Napoleon defeated in the Battle of the Pyramids in 1798. (*See* Napoleon; Nelson, Admiral Horatio.)

The struggle between Turks and Mamelukes continued, and between 1803 and 1805 the capital was the scene of repeated battles, murders, and rioting and pillaging by soldiers. Albanian troops in the service of the Turkish governor revolted when they were not paid, and at first aided the Mamelukes. The Albanian

leader, Mehemet Ali, styled the "Lion of the Levant," later turned on the divided Mamelukes and in 1805 he was proclaimed pasha. His descendants have ruled Egypt ever since.

Even with Mehemet as pasha, the Mameluke beys still ruled most of Egypt outside of Cairo. Mehemet massacred many of the beys in 1805, and in 1811 he wiped out the Mameluke power forever by slaughtering more than 400 beys in a treacherous ambuscade at the citadel.

TREASURES FROM THE TOMB OF TUTENKHAMON



Centuries ago robbers gained entrance to the tomb of Tutenkhamon through the hole which can be seen under the great gilded ceremonial couch (above). The end of another couch can be seen, with its animal figure supports. The chamber beyond was crowded with furniture, jewels, and other possessions of the dead Pharaoh, like those shown on the preceding page. At the right is a scene in the inner chamber. The chests contained statuettes of the Pharaoh and other Egyptian divinities. Piled on them are model boats for the soul's use in its future life.

At the left of the picture above is the end of the great carved and gilded shrine which enclosed the canopic jars. On each side of the shrine stood the gold figure of a goddess stretching her arms to protect the king. The one seen here was the goddess Neith.

His power once established, Mehemet set up a regular army, replacing the Albanians and Turks with native fellahin and negroes. His forces subdued parts of Arabia, the Sudan, and Syria, and for a time held the island of Crete.

Mehemet repaired and improved the irrigation systems, that had been badly damaged during long years of internal strife. He introduced standards of European civilization, and started the rich cotton industry in Egypt. All this, however, he achieved only by terrible taxation, and by constant use of the *corvee*, or forced labor on public works.

In 1856 Said Pasha, son of Mehemet, granted Ferdinand de Lesseps the concession to build the Suez Canal, which was completed in 1869 (*see* Suez Canal).

Said's successor, Ismail, in 1867 secured the title of *khedive* from the Turkish sultan. Ismail sold the control of the Suez Canal to the British for a huge sum, but his extravagances left the Egyptian treasury bankrupt, and in 1876 England and France took over international control of Egypt's revenues. In 1879, the sultan of Turkey ousted Ismail as khedive and placed his son, Tewfik, on the throne. Tewfik was unable to suppress the native resentment against the Europeans. Massacres of Europeans in Alexandria aroused Europe's powers, and late in 1882 the British landed troops in Egypt to oppose the forces of the *fellah* leader Ahmed Arabi, who had driven the khedive out of Cairo to Alexandria. British rule in Egypt dates to the victory of the British over Arabi in the battle of Tell-el-Kebir on Sept. 13, 1882.

Egypt Under British Control

Rebellion in the Sudan was the greatest handicap to the British in their efforts to stabilize the Egyptian government. An army of 10,000 Egyptians under a British colonel, William Hicks, known as Hicks Pasha, was wiped out in 1883 near El Obeid by the rebel leader Mohammed Ahmed, the "Mahdi" or "Prophet" of Sudan. "Chinese Gordon" fell in 1885 after the long siege of Khartum (*see* Gordon, Gen. Charles George). Not until 1899 was the Sudan finally pacified, and the Anglo-Egyptian Sudan established under control of the British and Egyptian governments.

Egypt prospered almost from the start of the British administration. The great dams at Assuan and Asyut added millions of dollars to the value of the country's products. Loans from London reclaimed the salt marshes of the delta and increased the acreage of the rice industry. Slave trading in the Sudan was all but eliminated. The corvee was abolished except when necessary to guard the Nile banks in flood time. The *kurbash*—forced labor under the lash—was outlawed.

France Recognizes British Rule

Egypt remained nominally under the rule of the Turkish sultan, but the British status was firmly

established in 1904 when France recognized British control of Egypt in return for recognition of French control in Morocco. This ended repeated efforts of France to secure a foothold in the Upper Nile.

When Turkey joined Germany in the World War in 1914, Britain proclaimed a protectorate over Egypt, ending Turkey's sovereignty. The title of khedive was abolished and Husein Kamel was named sultan.

But Egypt continued to be a troublesome ward. An independence movement, led by the Wafd (Nationalist Party), gained such strength after the World War that in 1922 Britain was led to proclaim Egypt an independent country, with Prince Fuad as king. The constitution, promulgated in 1923, established a parliament made up of a senate and a chamber of deputies. Suffrage is universal for men over 25 years of age. All deputies and three-fifths of the senators are elected. The king appoints two-fifths of the senators.

Britain reserved so many rights, however, such as defense of Egypt and control of the Sudan, that Egypt's independence was only nominal. The Wafd renewed its drive for real independence and in 1924 a Wafdist assassinated Sir Lee Stack, governor-general and sirdar of the Sudan. King Fuad tried to conciliate Britain and often dissolved Parliament to suppress legislation unfavorable to British interests. In 1930 the constitution was amended to give the King dictatorial power. Public dissatisfaction in 1935 forced a return to the old constitution.

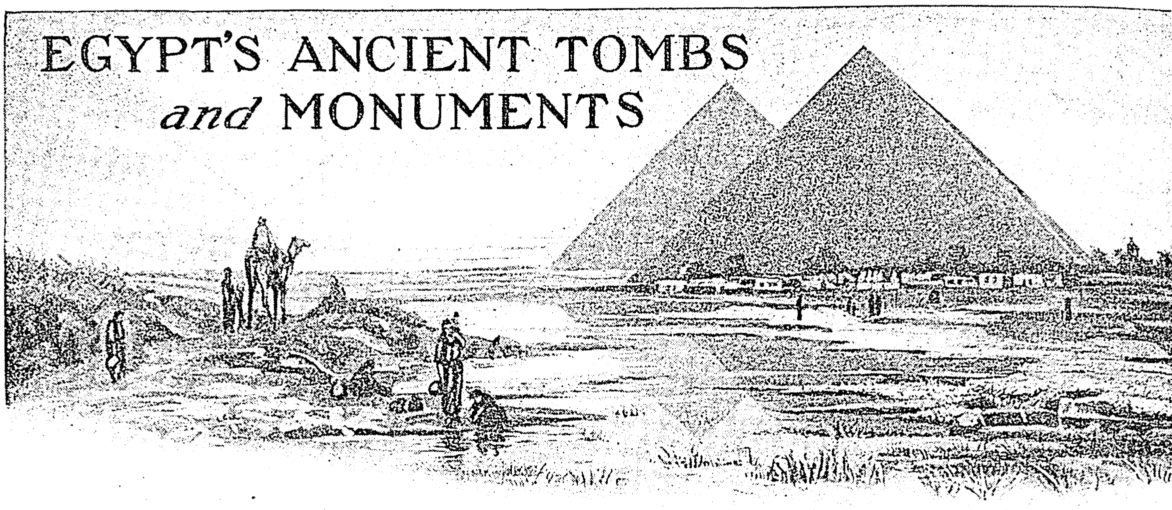
Upon the death of Fuad in April 1936, his 16-year-old son, Farouk, became king. He was crowned as Farouk I the following year.

Egypt Involved in European War

Greater independence was granted Egypt by the terms of a 20-year treaty of alliance that it signed with Great Britain in August 1936. The British promised gradual withdrawal of their military forces everywhere except from the Suez Canal area, but Egypt was required to render full aid in the event of attack. The test came with the outbreak of the second World War. Egypt, though abstaining from a declaration of war, coöperated with the British in resisting first the Italian armies and later the combined forces of Italy and Germany. (*See also* World War, Second.)

A NOONDAY PRAYER AT THE OASIS

This Egyptian has just come safely across a stretch of desert. He is thanking the Mohammedan Allah for his protection. The scene is typical of upper Egypt.



AND now let us take a steamer at Cairo and voyage up the Nile to read the story, going back 6,000 or 7,000 years, that its tombs and monuments have to tell. Nowhere else in the world can we find so complete a history of man's progress for so long a time, and nowhere else can we trace so fully the links in the chain which led him up from barbarism.

The Nile valley was the chief cradle of the earliest civilization, in the days when men first learned to erect buildings more permanent than mud-daubed huts and to fashion metals and make written records. The hot drifting sands and rainless atmosphere of Egypt have also preserved the remains of that civilization in greater abundance than those of any other early people. In burial pits of the late Stone Age, scooped out in gravel beds below the sand, we find the bones of Egyptian peasants and chiefs who died more than 6,000—some scholars think 10,000—years ago. By their side lie stone implements and pottery, which tell us that though they had not learned the use of metals, they were skilled at molding and baking clay into jars to hold food and drink. Picture records show local chieftains controlling the irrigation ditches and collecting taxes of grain and flax. Fragments of linen, small stores of barley and spelt wheat, vase-paintings of boats with oars and sails, give us further glimpses into the life of those old Nile dwellers in that far-off time. (*See* Stone Age.)

The Earliest Dawn of History

Stop for a moment to think how ancient these records are. Think back 2,000 years to the shadowy figure of Queen Cleopatra, last of the ancient rulers of Egypt. How long ago that seems! But go back another 2,000 years before Cleopatra, and Egypt was already an ancient empire with 1,400 years of known history! No wonder an Egyptian priest said to the Greek historian Herodotus, about 450 years before Christ, "You Greeks are only children!"

Go back to about 4000 B.C. and we reach the time when some unknown Egyptian discovered strange metallic beads melted from the copper-bearing rocks with which he had banked his camp-fire, and so learned the use of metals. Go back another thousand years—to about 5000 B.C.—and we find these mysterious people of the dawn of history already irrigating their fields of flax and wheat, weaving beautiful stuffs of linen, and making pottery; though their only tools were of stone and bone and their only houses were wattled mud huts.

Only a generation ago this fascinating chapter of the world's oldest history was unknown. It is only within the last few years that the men of science we call archeologists have discovered it, and read its pages by delving in the sands and uncovering the burial pits of four, five, and six thousand years ago.

Tombs of later dates continue the story. They show us how the ancient Egyptians learned to make paper from the papyrus plant, how they developed their early picture writing into alphabetic writing (*see* Writing), how they learned to mold bricks, cut stone, and carve statues. And not only do we find their paintings, their pottery, their jewels, their tools, their wooden chairs, and their papyrus books, but we even find the bodies of the men who made and used these things; for their mummies are so perfectly preserved by embalming that we can compare their features with the portrait statues of their kings and see how well the sculptor caught the likeness (*see* Mummy).

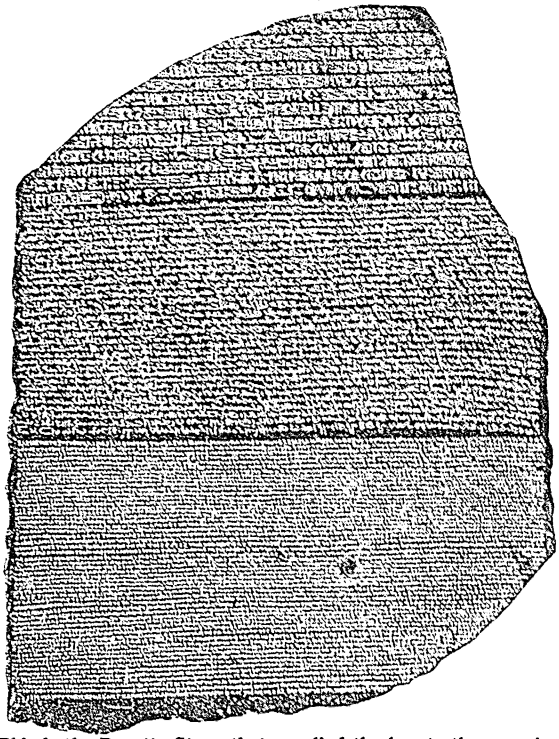
The Rosetta Stone Supplies the Key

Much of this marvelous story would still be a sealed book to us if it had not been for the famous Rosetta stone, which gave scholars the key to the long-forgotten "hieroglyphics" in which the inscriptions and papyrus books were written. This is a thick slab of black basalt, about as large as the top of a sewing machine, discovered by Napoleon's soldiers while digging trenches near the Rosetta mouth of the Nile in 1799. On it is inscribed a record in honor of one

of the kings of Egypt in 195 B.C., written in two languages—in Greek, which was then the official language of the government, and in Egyptian, both in the ordinary Egyptian characters (demotic), and in the ancient sacred hieroglyphics. By comparing the Greek translation with the Egyptian texts an ingenious French scholar named Champollion was able to discover the meanings of the ancient hieroglyphics and to begin the reconstruction of the Egyptian language. Other scholars took up the work, and thus the secrets have been discovered of the strange inscriptions over which scholars had so long puzzled in vain.

Now, how did it happen that the Egyptians took such pains to preserve their bodies, their records, and the objects of their everyday life? The answer lies buried deep in their religion. "The Egyptians," wrote Herodotus, "are the most religious of all men." They believed, as the Christian does, that the soul lives on after death, and that it will be judged by the great god Osiris for the deeds done on earth. They also believed that the soul can return to its body, and eat the food and drink prepared for it, read the sacred texts, and enjoy the other comforts laid away in the tomb. So their earliest pharaohs—so the Egyptians called their kings—built themselves great brick-walled tombs in the ground, and by 3000 B.C. they had begun constructing enormous stone pyramids to keep their bodies safe through the ages.

THE KEY TO THE STORY OF ANCIENT EGYPT



This is the Rosetta Stone that supplied the key to the meaning of the mysterious hieroglyphics in which the inscriptions of ancient Egypt were written. The stone is about as large as the top of a sewing machine and is a thick slab of black volcanic rock. The inscription on the stone was written in hieroglyphics, in ordinary Egyptian characters called "demotic" and, finally, in a Greek translation, and so the scholars were able to read this stone, and piece together a kind of hieroglyphic dictionary to be drawn on for reading other Egyptian writings.

Egypt United under King Menes

As we steam up the Nile, let us make our first stop at Thinis, near Abydos, about 350 miles south of Cairo. Here was born King Menes, the first pharaoh who ruled both Upper and Lower Egypt, uniting them about 3400 B.C. Before the time of Menes the dwellers in the low swampy lands of the Nile delta had also developed a civilization as high as that of the upper Nile, perhaps higher; for we know that in 4241 B.C.—*the first event in history to which we can give an exact date*—they invented a yearly calendar with 12 months of 30 days each, and five feast days at the end to make out the full 365. This is very much like the calendar we are still using, and it was a great advance over the early reckonings by moon months of 28 days. The shifting silt brought down by the Nile has long since buried hopelessly the remains of the early delta civilization, and we have to begin our story of Egypt far to the south.

At Thinis we go to see several underground brick-walled tombs, one of which may be that of King Menes himself. Ivory and ebony tablets and inscribed jewels—including a gold bar that belonged to King Menes—tell of the deeds of these earliest kings, of their well-organized administration, and of their wars with the desert tribes and other outside peoples.

The Pyramid Age (about 3000-2500 B.C.)

For the second great chapter in Egyptian history we have to go back down the Nile to the site of King Menes' ancient capital, the royal city of Memphis, about 12 miles south of Cairo. The city, once about 12 miles in circuit, was destroyed by the Arabs in the 7th century, and the sun-dried bricks of which it was built have long since crumbled into dust. Nothing remains but a few blocks of granite, sculptured fragments, and rubbish heaps.

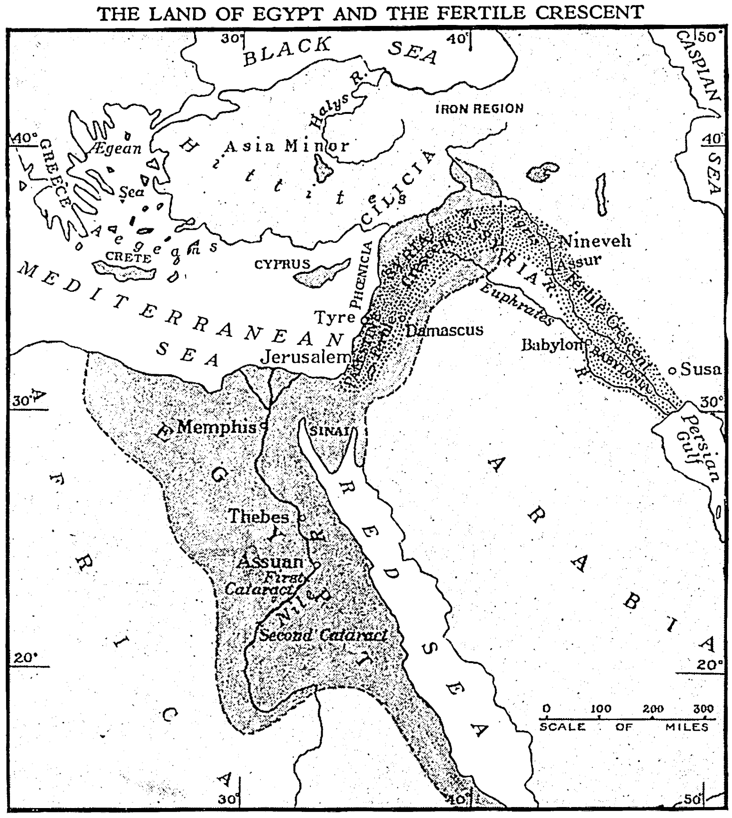
The city of the living has vanished, but not so the city of the dead. The colossal pyramids still stand which the ancient dwellers of Memphis built to protect the bodies of their kings. If we should soar in an airplane above the site of Memphis, we could see a straggling line of these vast edifices of masonry extending more than 60 miles along the Nile. Each pyramid marks the last resting place of one of the pharaohs of the Pyramid Age, which continued from about 3000 to 2500 B.C. The lonely chamber hidden deep within each of these piles once housed a royal mummy, bedecked with jewels and costly raiment. But ruthless hands ages since opened the sarcophagi (stone coffins) and robbed them of their treasures.

Near the site of Memphis we visit the oldest surviving building of stone masonry, the step-pyramid of King Zoser, erected not much after 3000 B.C. This earliest "pyramid" was really a series of flat tomb structures built one on top of the other in diminishing sizes, but it suggested the pyramid form.

Not more than a hundred years later King Khufu (or Cheops) was building the Great Pyramid in the cemetery of Gizeh opposite Cairo. This mass of masonry covers 13 acres, each side being 755 feet or nearly two blocks long, and the height nearly 500 feet. It contains 2,300,000 blocks of limestone, each as heavy as a large wagonload of coal. Herodotus says that 100,000 men spent 20 years building it, and modern archeologists believe it may have taken even longer. (*See* Pyramids.)

Scarcely less gigantic is the near-by pyramid of King Khafrē. Before it, endlessly sentineling the tomb, stands the great Sphinx, that riddle of the ages whose meaning we have only just learned. Now we know that the Great Sphinx of Gizeh was the portrait head of Khafrē, attached to the body of a lion, just as most of the other sphinxes of Egypt were portrait heads of other buried pharaohs. (*See* Sphinx.)

THE LAND OF EGYPT AND THE FERTILE CRESCENT



This map tells two important stories, one about how Father Nile was the making of Egypt, and the other about what is known as the Fertile Crescent. The earliest home of man in western Asia was on this crescent borderland between the mountains and the desert. And from here as well as from the Nile valley civilization spread to Europe.

Around the pyramids of the kings stand small flat-topped tombs of nobles and members of the royal house. As the pyramid had its temple, endowed with the income from many towns, so the tombs of the nobles had their chapels, where the priests served dinners of many courses for the mummy. Here, too, you will find the "pyramid texts"—prayers and incantations supposed to help the dead over the dangers of their long journey through the lower world. Later generations prepared a collection of these charms—on long papyrus rolls, some of them 90 feet long—and numerous copies of this have been found buried with the dead. From this fact the name 'Book of the Dead' has been given to this collection of religious texts.

Trade and Industry 5,000 Years Ago

The chapel walls are often covered from floor to ceiling with carved and painted scenes picturing the life of the great estate over which the noble once ruled. You see his herds of cattle, and watch the peasants hoeing and plowing and planting. You see also craftsmen working at their trades. Here is the coppersmith, hammering a saw out of a strip of copper; and there the lapidary who grinds out of diorite—a stone as hard as steel—bowls so thin they let the light through, or inlays turquoise into golden vases. Here also is the goldsmith making richly wrought jewelry; and the potter turning clay vessels on a potter's wheel and baking them in closed clay furnaces as tall as a man.

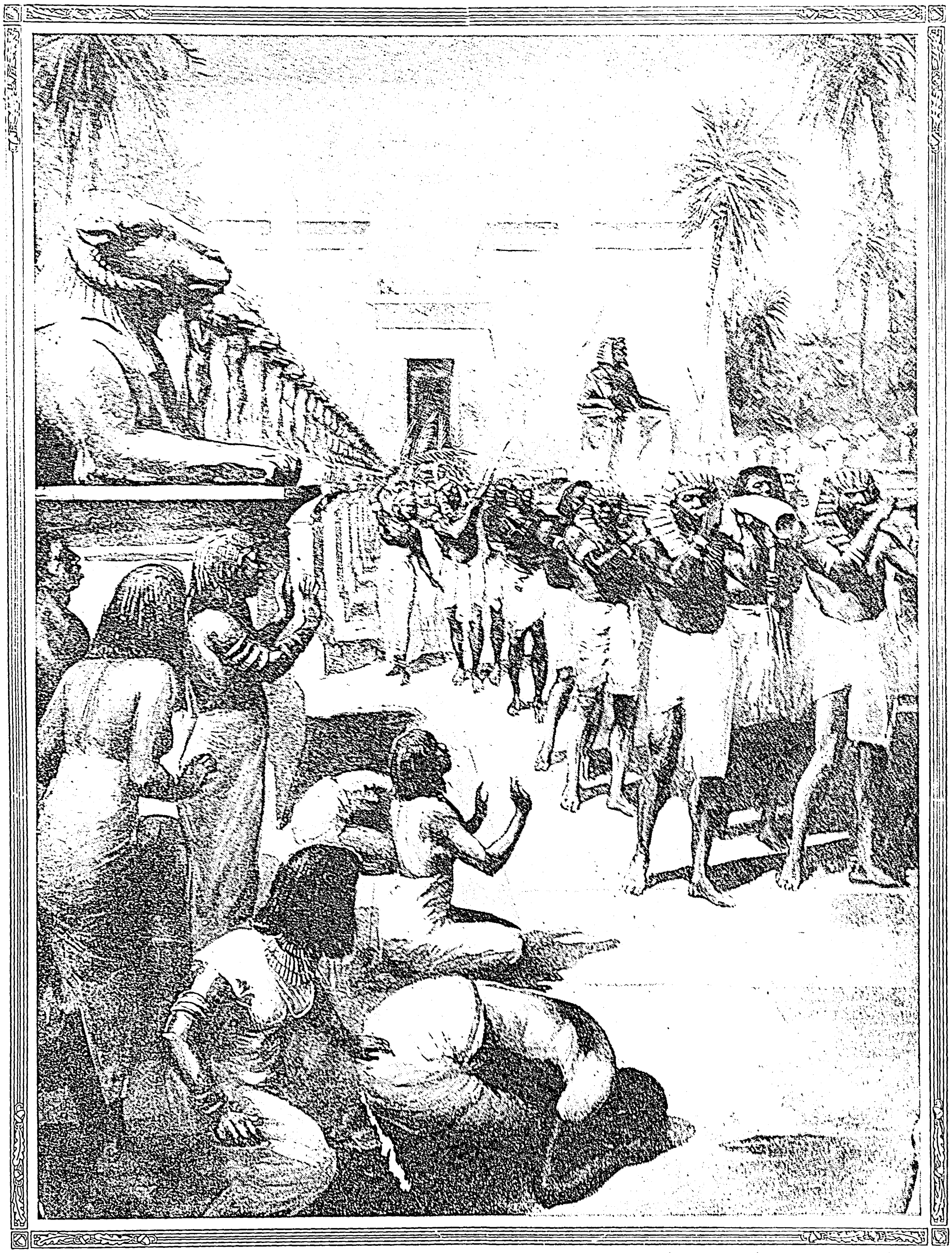
Glass, too, was made and used to glaze tiles, or fashioned into vases and bottles. Here, too, are weaving women making gossamer fabrics of linen, tapestries for the pharaoh's palace, or awnings for the noble's roof garden. Men are gathering papyrus reeds in the Nile marshes to split and paste together into strong double sheets of pale yellow writing paper. Ship-builders are making the typical Nile vessels with curving hulls, and cabinet-makers are busy upon chairs and couches to be overlaid with precious metals, inlaid with ebony and ivory, and cushioned with soft leather.

On another wall we find a scene in the market-place. Coins had not then been thought of, so the people are literally trading. The cobbler offers the baker a pair of sandals in return for a cake, and the carpenter's wife gives the fisherman a little wooden box.

In the Pyramid Age art was developing as well as industry. The painter had learned to observe life closely and to paint it in brilliant colors, although he did not know how to draw in perspective or show objects as having thickness and roundness. The portrait sculptor could make marvelous likenesses in stone or wood, colored to the life and with bright eyes of rock crystal.

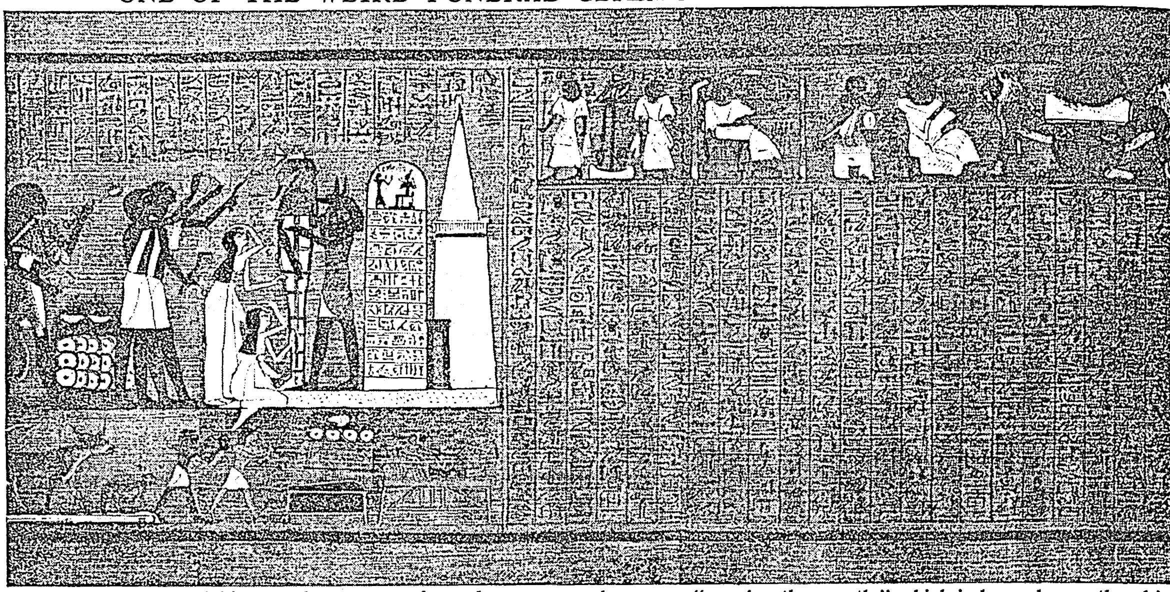
A glance at the massive temple standing near the pyramid of Khafrē shows us what progress the Egyptians of the Pyramid Age had made in the art of building. It is a splendid hall of granite with massive

PHARAOH ON HIS WAY TO THE TEMPLE



The magnificent temple of the god Ammon at Karnak was one of the greatest of Egypt's architectural achievements. To this sacred shrine of their religion, the Pharaohs went with music and with pomp. Here the Pharaoh has entered through the "pylon" archway between the two obelisks, and the procession is passing to the temple. The people are prostrating themselves, both because this is the sacred person of their ruler and because he was supposed to represent the whole nation when he appeared before the god in the temple. The queer looking figures of animals in rows on either side are sphinxes with ram heads, the ram being symbolic of Ammon.

ONE OF THE WEIRD FUNERAL CEREMONIES OF THE EGYPTIANS



When a mummy was laid away there was performed a ceremony known as "opening the mouth," which is here shown, the object being to supply the spirit of the dead with food and drink for its body in the other world. In this picture one priest is touching the mouth of the mummy with a certain instrument used in these ceremonies, and the other priest, standing beside him, is presenting vases of water. Behind these two is another official pouring out water for the dead, and burning incense. In later days a statue of the deceased took the place of his mummy in the ceremonies. This picture is from a drawing in the British Museum.

square pillars supporting the roofs which covered the three aisles—the central roof raised above the others. Openings in the walls which connected the middle roof with the lower roofs at each side admitted light, just as in the clerestory of the Gothic cathedral. In fact, this Egyptian temple nearly 5,000 years old, with its arrangement of three aisles and roof windows, contains the germ of the idea which the builders of early Christian days developed into the magnificent basilica and cathedral (*see* Architecture).

That the pyramid pharaohs were rich and powerful we can see from their ability to support the thousands of men at work on their monuments. Their treasuries consisted of storehouses and granaries, for taxes were paid in grain and live stock, wine, honey, and linen. At the central offices armies of clerks were kept busy with their reed pens and papyrus rolls. The pharaoh also sent donkey caravans to the Sudan for ebony, ivory, ostrich feathers, and fragrant gums, and ships to Phoenicia and through the Red Sea to the coast of lower Africa.

The Feudal Age of Egypt (about 2500–1800 B.C.)

The first great age of Egyptian civilization lasted about 500 years. A new epoch—which we may call the Feudal Age—begins about 2500 B.C., when the great nobles became powerful enough to wrest many privileges from the pharaohs, each ruling vast estates much as the barons did in the Middle Ages of Europe. To study this period we must sail about 200 miles up the Nile to the great cliff tombs overlooking the river, where the feudal lords are buried.

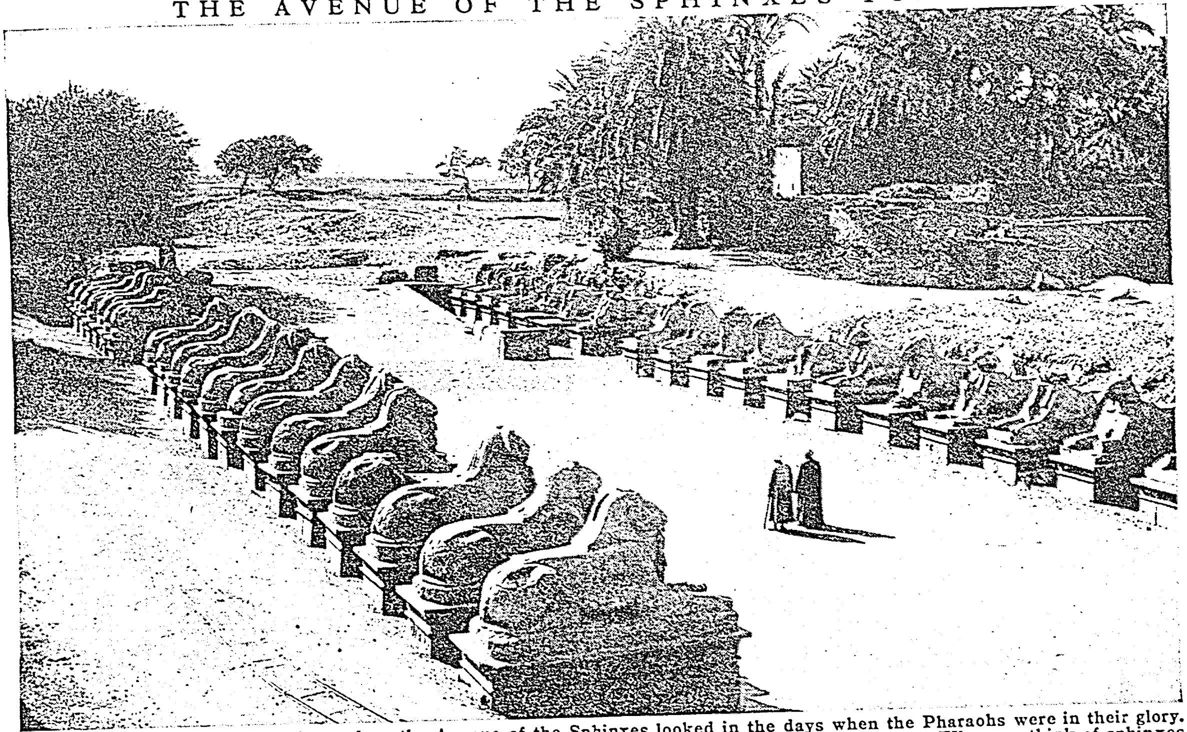
But even after visiting the tombs at the island of Elephantine, at Bersheh, Beni-Hasan, and Siut, we have caught only a glimpse of this period, for many of the most interesting objects discovered in the tombs were of the sort that must be moved instantly to museums for study and safekeeping. Among these are the oldest surviving books, rolls of papyrus once packed in jars neatly labeled. Some of them are story books, telling of shipwreck, of wanderings and adventures in Asia, or recounting wonder tales of old magicians. There are songs and poems in praise of the pharaoh, and a few works of science, including the oldest medical book we know of, a papyrus roll 66 feet long. In the tombs at Dashur were found the jewels of the princesses, among them a diadem of little flowers exquisitely wrought in gold. These are in Cairo. In the museums of Europe and America you will find some of the models of boats and of servants preparing food and beer.

The pharaohs of the time watched the Nile carefully and cut records of its various levels in the rocks. They built irrigation works, and dug a canal from the north end of the Red Sea to the nearest branch of the Nile. This served the purpose that the Suez Canal serves nowadays. They also kept a standing army and conquered Nubia as far as the Second Cataract, thus adding 200 miles of the Nile to the kingdom of Egypt.

The feudal period was at its height from 2000 to 1800 B.C. Its decline is marked by great confusion, usurper following upon usurper. Afterwards Egypt seems to have been ruled by a line of foreign kings who have been known for centuries as the Hyksos or shepherd kings. As the Hyksos ruled from the delta, their records and their capital will probably never be found.

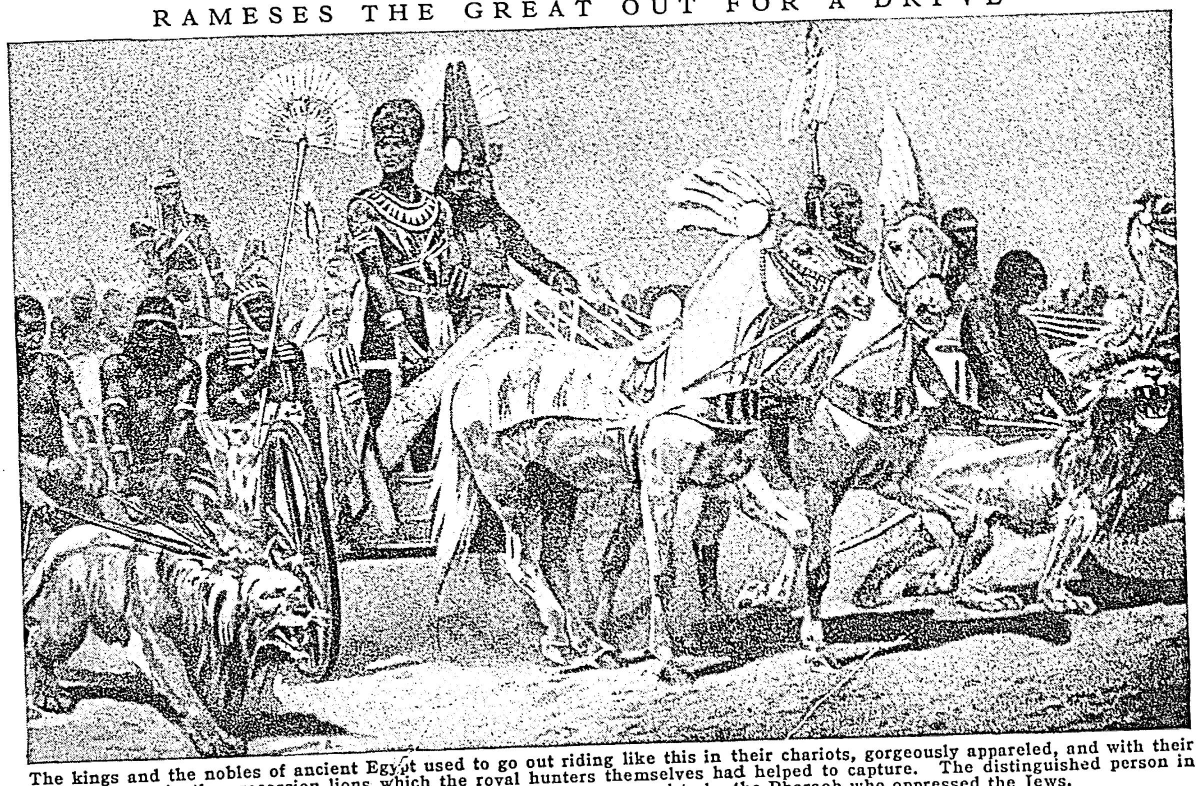
About 400 miles above Cairo the Nile valley sud-

THE AVENUE OF THE SPHINXES TODAY



You have seen in a previous picture how the Avenue of the Sphinxes looked in the days when the Pharaohs were in their glory. This is how the avenue looks today. These sphinxes have the body of a lion and the head of a ram. When we think of sphinxes it is usually either of the sphinx at Gizeh, whose face is supposed to be the portrait of the Pharaoh who erected it, or of the Greek sphinx which had the face of a woman, the feet and tail of a lion, and the wings of a bird.

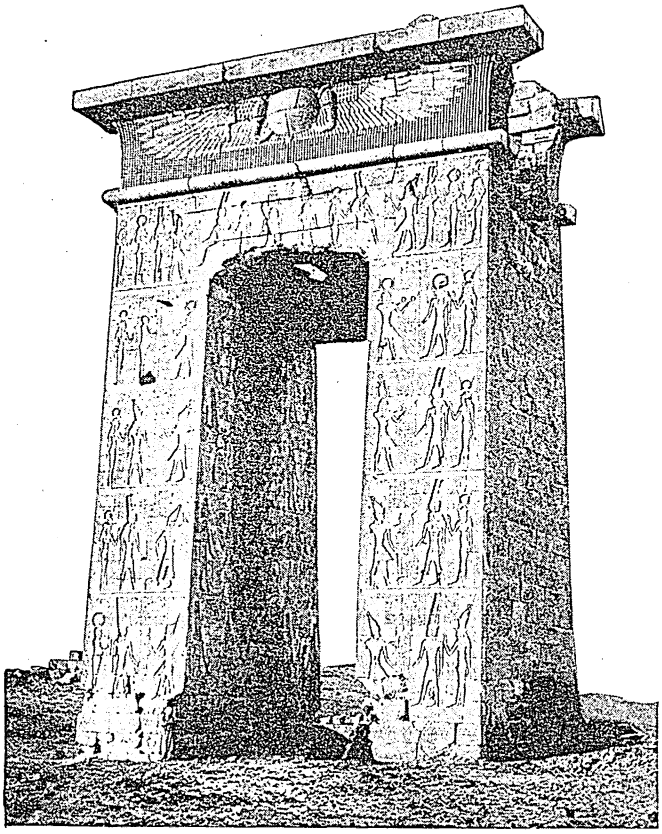
RAMESES THE GREAT OUT FOR A DRIVE



The kings and the nobles of ancient Egypt used to go out riding like this in their chariots, gorgeously appareled, and with their slaves leading in the procession lions which the royal hunters themselves had helped to capture. The distinguished person in this chariot is no other than Rameses II, who is supposed to be the Pharaoh who oppressed the Jews.

denly widens to a broad double bay in the hills. On our left we see masses of stone masonry and lines of

AN EGYPTIAN PYLON



One of the most impressive features of Egyptian architecture was the "pylon," an example of which is here shown. This pylon stands before the Temple of Karnak. On the pillars are inscribed scenes from the lives and deeds of Egyptian kings, just as on the arches of the Romans and the arches of today are told in sculpture the deeds of those in whose honor the arches are erected. Above the arch of the pylon is the Egyptian "winged sun."

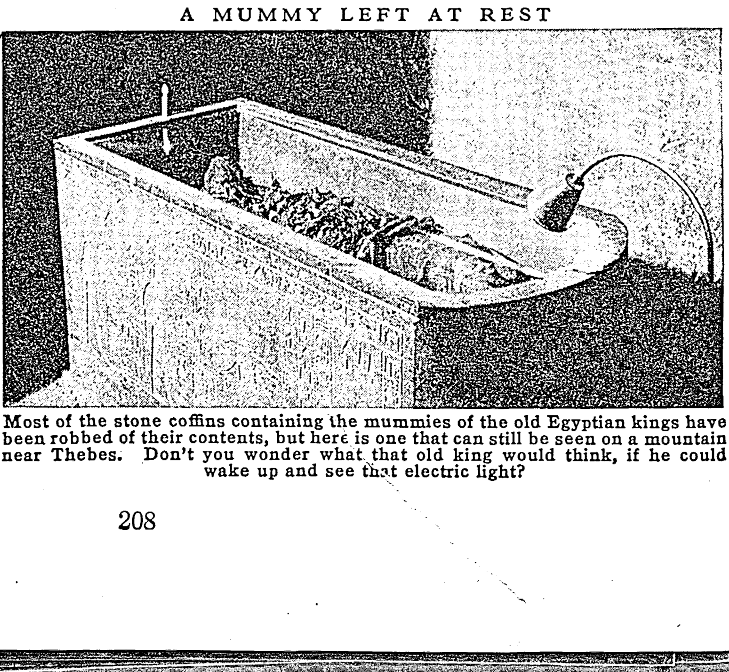
tall columns, memories of dead kings, rising among the palm trees and the growing crops. On our right, cream-colored with blue shadows against the vivid orange cliffs, are the pillars of tomb chapels—for the Egyptians thought of the kingdom of the dead as lying to the west, just as the soldiers in the World War used to speak of "going west" when a comrade was killed. On the west also, dipping their vast feet in the Nile flood, or hiding them in the growing crops, are the two colossal statues of Memnon, so huge that beside them a man becomes as small as a kitten nestling in your lap.

This is the plain of Thebes, and here we must remain many days to study the greatest period of Egypt—from the 16th to the 12th century B.C.—when the government was no longer a little valley kingdom, but an empire ruling from the Euphrates in Asia to the Fourth Cataract of the Nile. The modern center of the plain is Luxor, with its double row of columns along the Nile, its hotels, and the Arab village creeping up into the temple precincts. To the northeast lies Karnak. This tangle of vast temples built by various pharaohs is approached from the Nile by a broad avenue of ram-headed sphinxes. Karnak contains the greatest colonnaded hall ever erected. The columns of its central aisle are 69 feet high, and so large that 100 children could stand on the top of each. This one room covers as much space as the cathedral of Notre Dame at Paris. Near by stand sculptured figures cut from a single block 80 or 90 feet high, weighing as much as the entire load of a modern freight train. Sculptures in relief tell of Egyptian wars in Asia. Here for the first time we find the horse represented in sculpture, and so we are able to tell about when it began to be used in Egypt.

Within the precincts of Karnak and the many other great temples of ancient Egypt once dwelled an army of priests supported in idleness by immense endowments. Successive rulers lavished riches on the priesthoods, until they became great corporations, possessing vast wealth and landed estates worked for them by serfs. The power of the priesthoods was increased by the fact that they were the only learned class and were believed by their superstitious followers to have magical powers. The kings usually believed in the superstitions fostered by the priesthood, but whether they did or not, they supported the priests who in turn supported the royal power.

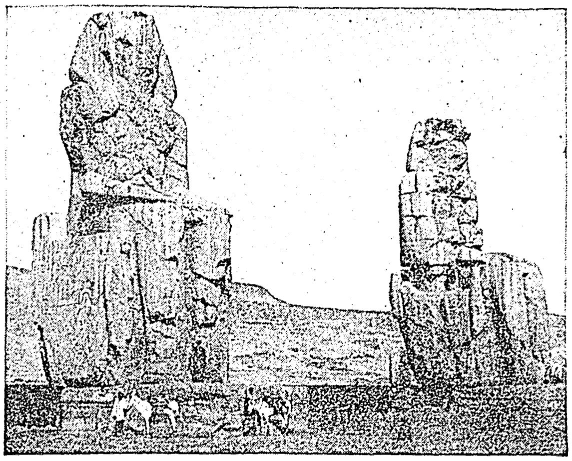
At Thebes the Egyptian kings and queens first become real people for us. Some of their tombs, tunneled into the rocks for a quarter of a mile remained unopened almost to our own day, and many of them have been left just as they were discovered. Through guarded doors you may pass through chambers and corridors to the central tomb

A MUMMY LEFT AT REST



Most of the stone coffins containing the mummies of the old Egyptian kings have been robbed of their contents, but here is one that can still be seen on a mountain near Thebes. Don't you wonder what that old king would think, if he could wake up and see that electric light?

THE STATUE THAT USED TO SING



These colossal statues of Amenhotep III standing near Thebes were supposed by the Greeks to represent the legendary hero Memnon. One of them was said to emit harp-like sounds at daybreak. Modern travelers say they have heard such sounds, caused by the air rushing through the pores of the stone when the hot rays of the sun suddenly expand it.

chamber, where the mummy lies in his sarcophagus, surrounded by furniture and jewelry.

One of the most sensational discoveries in the history of archeology was made here in 1922-23, when a party headed by Lord Carnarvon of England after eight years' patient digging uncovered the tomb of Tutenkhamon, the pharaoh who ruled about 1350 B.C. In it was found the most magnificent collection of Egyptian antiquities ever brought to light, for the vandals who ages ago looted the tombs of the pharaohs seem to have left Tutenkhamon's sepulcher little disturbed. The extraordinary beauty and workmanship of the bewildering mass of objects found here gave the world a new idea of the artistic heights which Egyptian civilization had reached.

Among the priceless treasures were four chariots, richly carved and ornamented with gold, ivory, and colored glass; several large ceremonial gilt couches, bedsteads, chairs, and stools; a throne, covered with gold and silver, and inlaid with semi-precious stones; life-sized wooden statues of the king; a number of boxes, some beautifully painted and others inlaid with ebony and ivory, containing clothing, mummified meats, and other articles. And in the inmost chamber, in an exquisitely decorated coffin under a huge double canopy blazing with beaten gold and precious stones, lay the mummy of the man for whose sustenance and comfort all these precious things had been laid away.

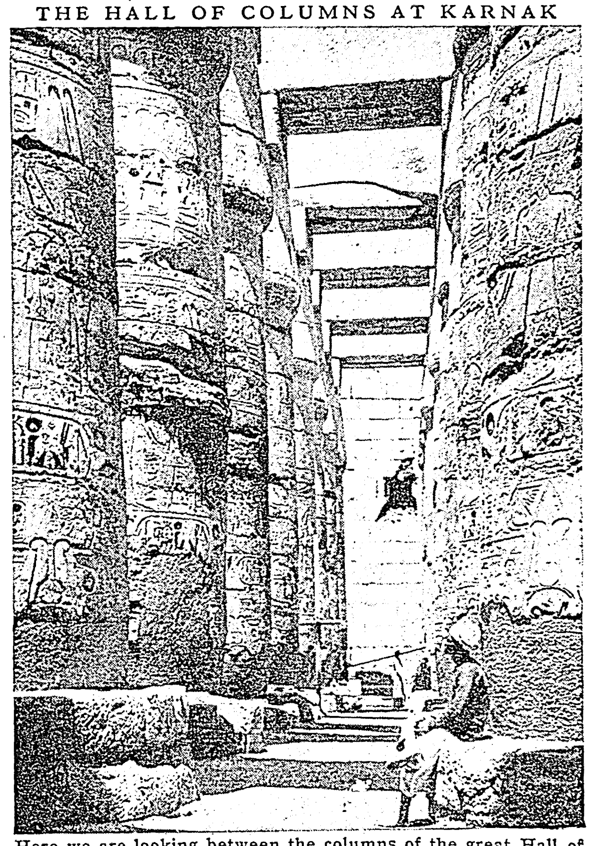
Another memorable find occurred in 1905, when the tomb and temple of Queen Hatshepsu were dug out of the sands. She was the first great woman of history, living about 1500 B.C. In the wall paintings of the dainty little temple, whose orange pillars at the foot of the cliffs are seen from the river, one may read her whole story from birth. We may participate in the wonderful expedition she sent to strange lands, and watch her mighty obelisks float down from the First Cataract in long Nile barges. These shafts of stone nearly 100 feet high, 8½ feet at the base, and weighing nearly 370 tons, would be a problem for the modern engineer to move. Smaller obelisks, however, have been moved from Egypt, notably the so-called "Cleopatra's needles" in New York and London.

Hatshepsu's successor, Thutmose (or Tethmosis) III—the Napoleon of ancient Egypt—also becomes a very real person for us. In his reign of more than 50 years, he conquered western Asia and made one of his generals governor of the Aegean islands. For some reason—possibly to wipe out the memory of the hated rule of a woman—he erased the name of Queen Hatshepsu from the monuments wherever he could, and walled up her great obelisks, one of which is still standing at Karnak with some of the concealing masonry clinging to its base.

Perhaps the most attractive figure of this period is that of the young king Ikhenaton, son of Amenhotep III and father-in-law of Tutenkhamon. He abandoned the ancient belief that there were many gods (polytheism) and tried to convert his people to the belief in one god (monotheism).

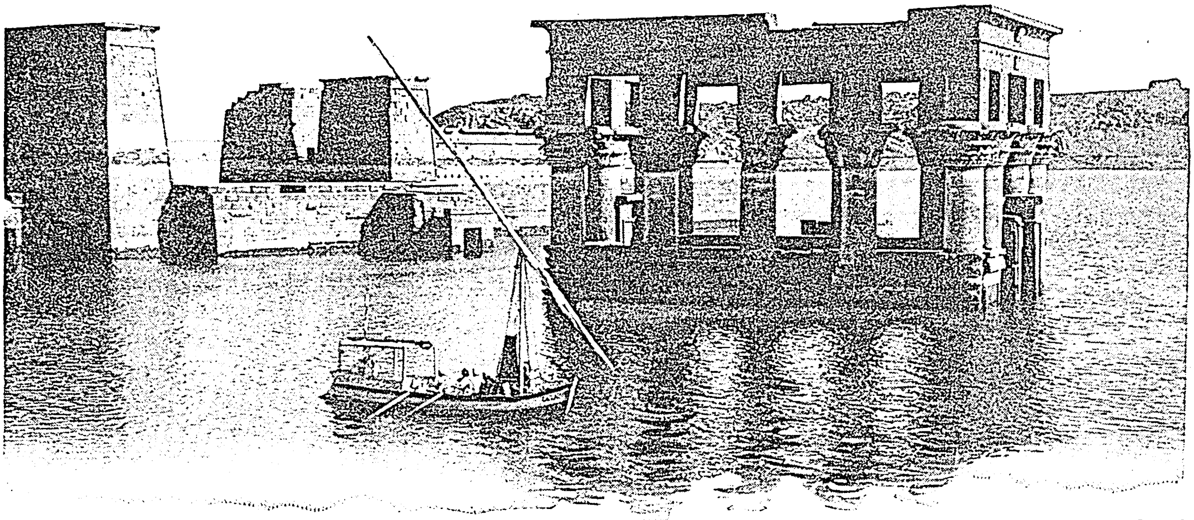
The number of deities in the Egyptian religion was prodigious, for at first every village seems to

THE HALL OF COLUMNS AT KARNAK



Here we are looking between the columns of the great Hall of Karnak. Turn back to the color plate in the article on Architecture and you will see how this magnificent structure probably looked 3,000 years ago.

THE BEAUTIFUL RUINS OF PHILAE



These are a portion of the beautiful ruins on the Island of Philae in the Nile. You can only see them during a small part of each year. The rest of the time they are covered by the waters of the Nile which collect behind the great Assuan Dam.

have had its own god or gods. Gradually most of the deities of the smaller communities had been forgotten, and there remained only the great gods of the principal cities. These were usually worshiped under the form of some animal, and in some places animals of these sacred classes were mummified after death. Vast cemeteries of mummified cats have been found at Bubastis, and crocodiles, lizards, bulls, ibises, and many other animals were similarly treated at various places and times. Chief among the Egyptian deities were the falcon-headed sun-god Re, worshiped in later times as Ammon-Re; Osiris, judge of the lower world, incarnated on earth in the sacred bull Apis (*see* Osiris); Isis, sister and wife of Osiris, represented by the cow (*see* Isis); Ptah, a craftsman and artist (like the Greek Hephaestus) and one of the creators of the world.

For these diverse and primitive cults, Ikhenaton attempted to substitute a single form of worship, the adoration of the power of the sun. Despairing of accomplishing anything among the many temples of the old worship at Karnak, he moved his capital to Amarna. There in a sculptor's ruined workshop has been found a portrait statue showing him as having the beautiful face of a dreamer. At Amarna also were found the famous "Tel-el-Amarna letters"—baked clay tablets inscribed with cuneiform characters—from the kings of western Asia to the pharaoh. These show us how the northern territory in Syria was being taken by the Hittites coming in from Asia Minor, and the southern by the Hebrews drifting in from the desert. The Hittites possessed weapons of iron, and this gave them a tremendous advantage over the Egyptians, who had only bronze weapons and tools.

RAMESES II

This is a statue of Rameses II, made from red granite. It was found among the ruins of the temple at Luxor.

But before the Egyptian empire fell, it flared up into one last blaze of glory under Seti I and his son Rameses II, the most famous of the pharaohs. If we had been casually voyaging up the Nile instead of sailing in search of history, we might easily have supposed that Rameses II was the only pharaoh Egypt ever had. From the Delta to the great rock temple of Abu Simbel in Nubia, where his colossal portrait statues look down from the cliff, his name is upon almost every building. He was the greatest builder of all the rulers of Egypt, but he also put inscriptions upon many buildings erected by his ancestors.

Rameses II reigned for 67 years, from about 1292 to 1225 B.C., waging long wars in Asia which restored much of Egypt's lost prestige there. He may have been the pharaoh who so grievously oppressed the Israelites, as we read in the Bible.

But the time now came when Egypt was to be the conquered instead of the conqueror. The country was subdued by the Assyrians in the 7th century, and by the Persians in the 6th. It remained a Persian province until 332 B.C., when Alexander the Great seized it.

Alexander's conquest meant for Egypt a new great age, for under Ptolemy I—the Macedonian general who took Egypt as his share after the death of Alexander—and his descendants, it was again ruled not as a province but as an independent country. From Alexandria, the harbor city which the Ptolemies took as their capital, Egyptian fleets ruled the seas from the Indian Ocean to the Hellespont. The Ptolemies also reconquered Palestine and southern Syria, and made Alexandria the commercial, literary, and scientific capital of the world (*see* Alexandria).

That beautiful city, however, lies buried far under the busy modern city of Alexandria; so perhaps the best way to get a glimpse of the last great chapter of Egypt's long history is to travel still farther up the Nile to the island of Philae, above the great dam at Assuan. The Ptolemies left many temples, new or remodeled, along the Nile, but none more exquisite than the temple of Isis among the palms of Philae, which is now under water the greater part of the year.

After the death of Cleopatra, seventh and last of the Ptolemies (*see* Cleopatra), Egypt became a Roman province. At first Christians were persecuted, but later Alexandria became a great center of Christian leadership.

Rome regarded Egypt merely as a valuable granary and burdened the natives with cruel taxes. Among others, there were grain taxes, sales taxes, poll taxes, and inheritance taxes. Three centuries of Byzantine misgovernment followed the rule of Rome and left the Egyptians in a mood to welcome the Saracen conquest (641 A.D.) which came nine years after Mohammed's death. Ever since Mohammedanism has prevailed in the land of the Pharaohs.

EINSTEIN *and His Famous* THEORY *of* RELATIVITY

EINSTEIN, ALBERT. Albert Einstein was born at Ulm in Germany, on Mar. 14, 1879. His father was a Jewish merchant and manufacturer. In 1901 Einstein got a job as an examiner of patents in the Swiss patent office. Some spare time was available, which the young man used in studying physics and in physical and mathematical calculations. Then began the series of fundamental scientific papers which was to make his name the foremost one in theoretical physics since Isaac Newton. In 1905 he published his first suggestion of the theory of relativity.

By 1914 he had won a high place in the scientific world and had served as professor at the universities of Zurich and Prague. In that year German friends obtained his appointment as professor in the Prussian Academy of Sciences in Berlin and director of the Kaiser Wilhelm Institute for Theoretical Physics. In 1921 he received the Nobel prize in physics, and in the next few years he traveled widely abroad, lecturing on both physics and Zionism, which he considered the best practical solution of the Jewish problem. When the Nazis came to power, they confiscated his property and publicly burned his books. In 1933 he was appointed for life a member of the Institute for Advanced Study at Princeton, N. J. In 1940 he became an American citizen.

By 1909 he had developed his *special theory of relativity*, and between 1913 and 1915 he developed his *general theory of relativity*. Since 1929 he has been working out his *unified field theory*, which seeks to relate relativity, gravity, and electrical force in a single theory, with all phenomena explained from one set of basic assumptions.

Difficulties in grasping the Einstein theories are partly real, partly imaginary. In their exact form, they are mathematical formulas derived through a mathematical technique that is complex and formidable even to students of higher mathematics and, of course, unintelligible to the layman. But when the general significance of these formulas is expressed in words, there need be nothing obscure or technical about the language used. If they trouble the layman, it is because he cannot at first believe that they really mean what they say.

An Example of Relative Motion

To forestall this difficulty so far as possible, let us approach these statements with an example of relativity that is in no sense dependent upon the Einstein doctrines. Imagine an airplane flying across the sky (Fig. 1). Rigidly attached to the body of the plane and projecting toward the ground is a long, straight, perpendicular tube of glass. When the plane in its flight reaches position A, an observer aboard it drops a black marble down this tube. It falls, under the influence of gravity, with increasing speed, so that as the plane passes in turn through positions B, C, D, E, and F, the marble in each case has reached the position indicated by the black dot.

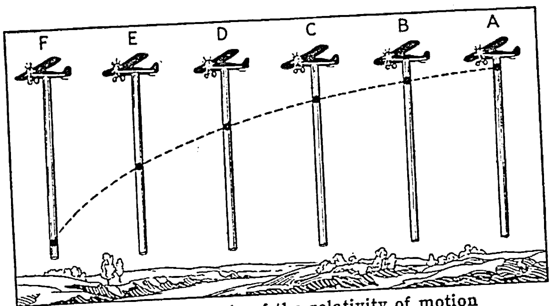


Fig. 1. An example of the relativity of motion

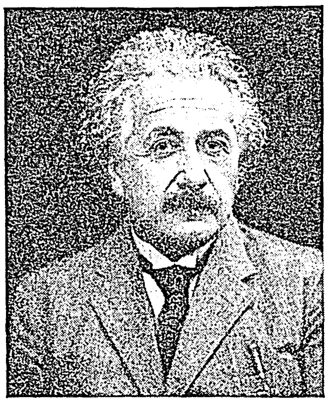
How can we describe correctly the path of that marble? To the observer in the plane looking down through the tube, the marble is evidently following a perfectly straight course. But to you on the ground, as your eye follows the movement of the marble, its course is just as evidently a curve, represented in our diagram by the dotted line. Indeed, if it were dark, so that plane and tube were invisible, and if the marble were a falling flare, it would probably never occur to you that its path might seem straight to any other observer. This apparent contradiction is in no sense due to an

optical illusion. *Both observers are correct.* Relative to the man in the plane, the path of the marble does not merely *seem* to be a straight line; it *is* a straight line. And relative to you on the ground, it *is* a curved line.

Consider also the *distance* the marble has moved. So far as the observer in the airplane is concerned, it has moved only the length of the tube. From your standpoint on the ground, it has moved a much greater distance. Its speed of motion, then, as well as its path differs according to the point of view.

You may say that the observation from the ground is the more correct one, since by common consent we always refer measurements to points that are at rest. But the earth is not at rest. Its surface is rotating around its axis, its whole mass is revolving around the sun; the sun itself is moving toward the star Vega, which may in turn be traveling unknown paths. However fully it may serve the practical purposes of daily life to refer motions to "fixed" points on the earth's surface, it fails completely to satisfy the requirements of physical theory. What is needed is a point of universal reference known to be *absolutely* at rest.

MASTER OF RELATIVITY



Albert Einstein

Einstein's Basic Principles

Einstein's first principle of relativity says in substance that if any such point exists, we can never find it out. All motion must therefore be considered as relative motion. It was thought, at one time, that the theoretical "ether" through which all heavenly bodies were supposed to be moving might provide a gauge of absolute motion. Light was believed to consist of waves of this ether which might reveal by their "drift" the real speed of the earth through space. The most careful experiments failed to record any such drift (*see* Ether; Michelson, Albert).

The second principle of relativity is that the apparent velocity of light in empty space is not affected by the motion of the observer or of the source of light. This is one of the statements that seems at first to challenge our common sense. If we are measuring the velocity of a light beam that is coming to us from the sun, we would naturally suppose that this velocity should appear to be greater if we are moving toward the sun than if we are moving away from it. According to Einstein's principle we can never detect any greater or smaller relative velocity by this or any other experiment. And when we think it out, we see the reason plainly. Every experiment for measuring the velocity of one light beam must rely for its observations and records directly or indirectly on the velocity of other light beams. (*See* Light.) If our motion affects the velocity of the beam we are measuring, it has a proportional effect on our measuring methods, and we can never distinguish a difference. Every test that has been made of light's velocity bears out this theory.

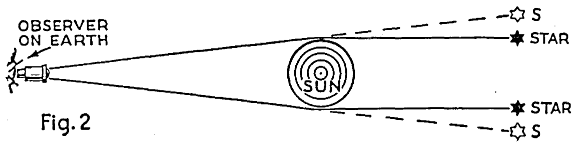


Fig. 2

As light beams from stars pass near the sun, they are bent out of their course, so the stars seem to be further apart than when the sun is not there. The diagram shows the reason for the apparent shift in position. Einstein's theory about the relation between mass and energy enables the degree of shift to be accurately predicted. Such observations can be made only when an eclipse renders the stars visible.

An Amazing Conclusion

Let us see to what conclusion this apparent uniformity of light velocity, regardless of our motion, leads us. We will use an exaggerated example for the sake of emphasis. Suppose we are on a train that is moving with one-half the velocity of light toward a searchlight that has just been turned on. As the front of the light beam passes from the head of the train toward the rear, the rear end of the train is coming forward to meet it. To reach the rear end, the light beam has to travel only two-thirds as far as it would if the train were standing still. Yet it will *seem* to take just as long to go the shorter as the longer distance. The reason for this deceptive result, according to the Einstein theory, must be due to two factors—our judgment of length and our judgment of time.

When we make the measurements on which our computation of the velocity of light is based, the number of units of length covered by the moving light beam *seem* (due to the relative motion) to be equal in both cases; and the number of units of time also seem equal. This could take place only if the units of length appeared shorter, so that the same number would fit into a briefer span, and if the units of time appeared longer, so that the time elapsed on the shorter journey would appear as great as that on the longer journey. That is exactly the conclusion to which the Einstein theory leads.

It tells us, in other words, that when we view any system that is moving relative to ourselves, it appears to be shortened in the direction of motion and its time intervals appear to be lengthened.

Relativity of Time

It has always been obvious that time was a relative conception, for it depends upon motion for its meaning. Try as you will, you cannot define time or any unit of time except as something associated with motion. Every time-measuring device, from a sun clock to a chronometer, depends on the motion of some object, either a heavenly body, a pendulum, or a balance wheel. But it remained for Einstein to reduce this time relativity to an exact mathematical statement, relating it to

the constant value of light's velocity, so that it can be introduced as a basic factor into mathematical computations which previously involved only space measurements.

Out of this relation grew naturally one of the most fruitful of Einstein's later theories—the theory of the *space-time continuum.* This has been called, although inaccurately, a "four-dimensional space," with time as a dimension similar to length, breadth, and thickness. A closer approach to the idea may be obtained by remembering that observers in any system will see time as "running slow" in any other system moving relative to the first one. Therefore no observer can identify any instant in another system corresponding to the instant of "now" in the observer's own system. Consequently we cannot divide time into past, present, and future for the universe. What seem to be time differences may actually be space differences; so space and time must be considered as aspects of a single unit or *continuum.*

Similarly, Einstein presents mass and energy as varying aspects of the same thing (*see* Physics). Gradually he has worked gravitation and electricity into this general picture; and a development of his theory, announced in 1935, presents the universe as a structure of two "space sheets," linked to each other by "bridges": each "bridge" gives rise to phenomena which we associate with atoms and electrons. By applying new mathematical formulas, Einstein calculates phenomena of light, gravitation, electricity, magnetism, and movement in space. He hopes in time to reconcile the conflict between the wave and quantum ideas of electromagnetic phenomena (*see* Radiation). Many apparent changes in motion may be due to curvatures, or distortions, in space, according to this view.

Validity of the Einstein Theories

Neither Einstein nor his followers would maintain that these theories are "true," in the absolute sense. In fact, the theory of relativity carries within it a denial of the idea that we can hope to know the "absolute truth," in a scientific sense, of any physical phenomena. What we can hope to do is to describe with mathematical accuracy all the *appearances* of truth which we see. Einstein has succeeded in doing this in several cases which defied explanation by older theories resting upon "absolute" time and space. One such case was the failure of the planet Mercury to reach the perihelion of its orbit at the point called for by older astronomical theory. Another was the apparent shift in position of stars seen near the sun during a solar eclipse (Fig. 2). Both phenomena "figure out" exactly, when Einstein's theories are applied.

The Einstein theories do not affect any of the measurements entering into everyday life. They come into play only when we deal with motions approaching the speed of light, and in advanced theories concerning atoms and electricity.

ELBE (*ĕl'bē*) **RIVER.** After the Rhine, the Elbe is Germany's most important river. It is 725 miles long, with about 525 miles navigable for large boats. Its drainage basin, about the size of Illinois, covers 56,000 square miles. In this basin lie Germany's chief sugar-beet fields and many grain farms, pasture lands, forests, mines, and factories. The river's cargoes of coal, lumber, salt, fertilizers (potash), sugar, wheat, rye, cattle food, paper, glass, and machinery total millions of tons each year.

The Elbe rises on the southern side of the Riesen Gebirge ("Giant Mountains") in Bohemia. It curves west and north, and then breaks through the Erz Gebirge ("Ore Mountains") into Saxony, crossing a district called "the Saxon Switzerland." Thence the river continues northwest across the German plain. At Hamburg it flows into the North Sea through a broad fan-shaped mouth, or estuary, 75 miles long.

Navigation for large boats begins at Melnik in Bohemia. The chief ports downstream include Aussig, Dresden, Riesa, Wallwitzhaven (port for the city of Dessau), Schönebeck, Magdeburg, Hamburg (continental Europe's greatest seaport), and Cuxhaven.

Much freight enters the Elbe from its tributaries, the Moldau (Vultava), the Saale, and the Havel. At Magdeburg, the Mittelland-Kanal (Midland Canal) connects the Elbe with the Rhine, the Ems, and the Weser, to the west; and with the Oder, to the east. The Elbe-Trave Canal leads to the Baltic port of Lübeck, and the Kiel Canal links the river to Kiel, Germany's chief naval port on the Baltic.

ELDER. The white blossoms of the shrubby elder plant adorn many a country lane in June, to be followed later by clusters of dark red, purple, or black berries that in old-fashioned households were made into spicy elderberry wine. Of the twenty or more species of the elder, five are native to the United States. They range from Nova Scotia to the Gulf of Mexico, and westward some 2,000 miles. Most common is the American elder which grows profusely in rich, moist soil throughout the eastern states.

Scientific name of American elder, *Sambucus canadensis.* Flowers growing in flat-topped clusters at ends of branches; tiny calyx and corolla of 5 spreading lobes; 5 stamens; 3-parted style. Stem smooth, pithy, from 4 to 10 feet high. Leaves opposite, pinnately compound.

ELECTIONS. It has been said that if three men of Anglo-Saxon race were cast away on a desert island, they would hold an election and form a government. English-speaking peoples are so familiar with elections —class elections, club elections, as well as political elections—that they organize meetings and hold elections instinctively.

In the United States most states have primary elections of the political parties to nominate candidates (*see* Primary Elections), as well as the ordinary elections for electing local, state, and national officers or passing on measures submitted to the people. Most elections are now by secret ballot (*see* Ballot). Election officials are sworn and their expenses are usually paid out of the public treasury.

In some elections the person or measure must receive an actual majority of all votes cast to be successful. Thus, if A receives 100 votes, B 80, and C 60,

A has not a majority, as he received only 100 votes out of 240, or less than half of the total number of votes cast. If A had received 200, B 80, and C 60, A would have a majority of 30. In most elections, a plurality only is necessary for the candidate to win. In the first instance above, A has a plurality of 20 votes over the next highest candidate, and so would ordinarily be declared properly elected.

ELECTRIC BATTERY. In 'The Arabian Nights' we read of powerful spirits or jinns that were imprisoned in bottles awaiting to serve the first man who released them. Modern electric batteries are almost a realization of those old fairy tales, for they contain energy that can be released at will in the form of electricity. They perform thousands of useful tasks for us. They light the lamps of automobiles and speeding trains; they operate telephone systems and railway signals; they run huge trucks; they furnish ignition for gasoline motors; they ring bells and fire alarms; they provide current for radio receivers, for electroplating, and for refining metals. They are made in countless sizes from the tiny cells for pocket flashlights to the huge batteries that drive submerged submarines.

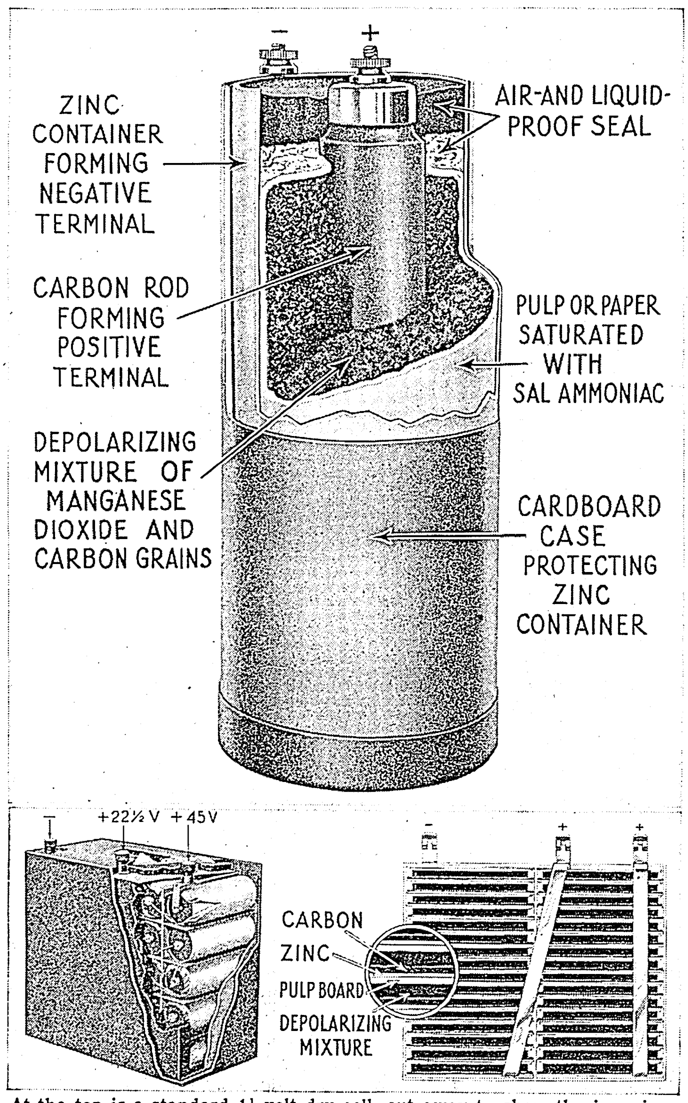
Alessandro Volta was the magician who first imprisoned the spirit of electricity so that it could be carried around and used where most convenient. Spurred on by the experiments of Galvani (*see* Electricity), he discovered that electric current could be produced by chemical action. He found that when plates made of two different metals were submerged in an acid, or a salt solution, an electrical current would flow through a wire connecting these plates. In 1799 he constructed his first effective cell (several cells go to make up a battery), using a zinc plate for his negative terminal, a copper plate for his positive terminal, and a weak solution of sulphuric acid for his electrolyte.

When a simple voltaic cell of this type is in action, the negative terminal gradually dissolves and hydrogen is formed on the surface of the positive terminal, escaping in bubbles to the surface. Unfortunately, some of the hydrogen clings to the positive terminal, forming a film which rapidly diminishes the flow of current, finally cutting it off entirely. This phenomenon, called *polarization*, had to be controlled in some way before batteries could become commercially practical.

For more than fifty years after Volta's discovery scientists struggled with this problem. Numerous cells were devised, some of them useful in their day, but now virtually forgotten. Chief of these was the Daniell cell, using a zinc plate immersed in a solution of zinc sulphate and a copper plate immersed in a solution of copper sulphate, the two solutions being separated either by a porous cup or simply by the action of gravity which kept the copper sulphate at the bottom of the cell jar with the zinc sulphate floating above it. It was not until 1868 that Georges Leclanché invented the cell bearing his name which became the basis for most of the batteries in use today.

In the Leclanché cell a carbon rod takes the place of Volta's copper plate. Zinc remains as the negative terminal. The electrolyte is a

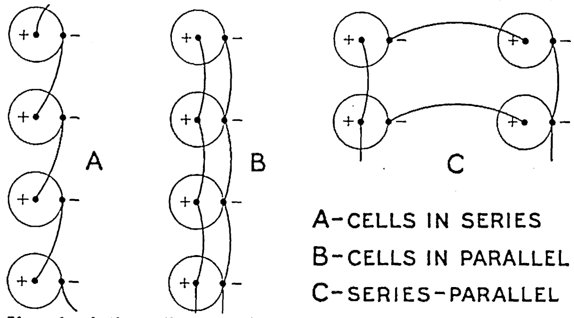
THE "INSIDES" OF A DRY CELL



At the top is a standard 1½-volt dry cell, cut away to show the ingenious arrangement of its elements. The purpose of the different parts of the cell is explained in the article. Below at the left we see how 30 cells, each a small duplicate of the one above, are packed and connected together to make up a radio "B" battery of 45 volts. If the middle binding post is used, 22½ volts are obtained. In the "B" battery at the right, the cells are built in layers but the chemical action remains the same.

solution of sal ammoniac instead of acid. But the distinctive feature of the cell is the use of a mixture of manganese dioxide and carbon grains which is packed around the carbon terminal and acts as a "depolarizer" by absorbing the hydrogen before it has a chance to form the objectionable film.

THREE METHODS OF WIRING BATTERIES



If each of the cells used is a standard $1\frac{1}{2}$-volt dry cell, then the battery connected in series A will yield 6 volts. If it is connected in parallel B, only $1\frac{1}{2}$ volts are available, but a heavier current (amperage) may be drawn from it. The series-parallel connection C will give 3 volts with a medium current.

The modern "dry" cell is an adaptation of the Leclanché principle. It is, of course, not really dry. The sal ammoniac solution is merely soaked up by the porous material inside the cell, so that it cannot spill out. If you take one of these dry cells apart, you will find that, under the outside protective covering of cardboard bearing the name of the maker, is a zinc cup which acts at once as a container and as the negative terminal. The outside brass binding post is fastened to its rim. The top of the container is made air-tight with sealing wax from the middle of which projects a binding post fastened to the top of a carbon rod. Beneath the wax and surrounding the end of the rod itself are layers of pitch and other protective materials. The inside of the zinc cup is lined with blotting paper or pulp board saturated with sal ammoniac. Between this and the carbon rod is the depolarizing mixture, also soaked with the electrolyte.

In the so-called "air cells" the supply of depolarizing oxygen is drawn from the surrounding air by means of a special kind of carbon terminal, which absorbs the oxygen from the air and feeds the required amount to the battery. The liberated hydrogen combines with the oxygen, forming water. Since the only electrolyte is water, this does no harm. Water must be added occasionally to offset evaporation.

Cell Voltage Is Limited

The voltage of any electric cell is determined by its chemical composition and cannot be increased by making the cell larger. The larger cell will, however, last longer and give more current. Wet and dry cells of the Leclanché type yield when new about $1\frac{1}{2}$ volts. If a higher voltage is required, several cells must be connected in *series*. This means that the negative pole of each cell is connected to the positive pole of the next one, leaving a negative pole free at one end of the line and a positive pole at the other. The voltage thus obtained is the sum of the voltages of all the cells in the series. Four dry cells in series, then, will form a battery of 6 volts.

The high-voltage "B" batteries used in radio consist of a large number of small cells connected in series and packed together in a case. A 45-volt "B" battery, for example, contains 30 small cells. In some "B" batteries the cell units resemble flashlight cells. In others they are made in flat layers: first, a sheet of carbon, then a layer of depolarizing mixture, then a sheet of wet pulp board saturated with sal ammoniac, and then a sheet of zinc. This is repeated until the requisite number of cells has been built up.

When only a low voltage is needed, but a large amount of current (amperage) is desired, the cells are arranged in *parallel*. All the negative poles are connected to one wire and all the positive poles to another wire. The resultant voltage will not be greater than that of a single cell, but the current supply will be multiplied by the number of cells in the battery. When both voltage and current supply must be raised, then a combination arrangement is used called a *series-parallel* connection. Two separate groups of cells are connected in series, and then the two groups are joined to each other in parallel. In this way virtually any combination of voltage and current supply can be obtained. The diagram shows these connections.

Primary and Secondary Cells

The energy of the cells in the type of batteries we have been considering comes from the reaction of the chemicals brought together first at the time of manufacture. When this chemical reaction ceases, such *primary* cells, as they are called, are "dead" and useless. Everyone is familiar, of course, with another type called *secondary* or storage cells. While these obey the same general principles that govern all electric cells, they have a reversible chemical action. When they are exhausted they can be recharged. In many respects they are more important than primary cells, for they are the ones used where great power is required. They deserve, therefore, a separate article (*see* Storage Battery).

ELECTRIC GENERATOR AND MOTOR. The transformation which electricity has brought about in our civilization could not have taken place if we lacked a method of turning mechanical power into electrical current. Useful as electric batteries are, they could never supply us with the vast amount of current we need to light our cities, run our streetcars, and drive our industrial machinery.

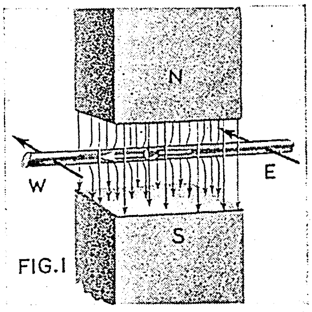
Michael Faraday, the great English physicist, was the father of the dynamo, or electric generator, as it is more commonly known today (*see* Faraday). It was he who first discovered that if a wire is moved through the field of a magnet (*see* Magnet) an electric current will be *induced* in the wire. This simple fact is the basis of virtually all our electric power.

The fundamental principles of electromagnetic induction are discussed in the article on Electricity. What we must examine here is the machinery for putting this force to work in a practical way.

Direction and Strength of Induced Current

The simplest application of Faraday's discovery is illustrated by Fig. 1. Here we show the two poles of a magnet pointing toward each other so that the lines of magnetic force cross from the north to the south pole in a straight path. Across their path a wire, W–E, is moving in the direction of the two arrows, that is, from the front toward the back of the picture. We must imagine that this wire is part of a circuit. So long as it remains in motion across the magnetic field in the direction indicated, a current will flow in the wire in the direction shown by the white arrow C. But if we reverse the motion of the wire, pulling it toward us through the field instead of pushing it away from us, the current flowing in the wire will also be reversed.

AN INDUCED CURRENT



The fact that the movement of wire across a magnetic field induces an electric current in the wire, as shown in this picture, is the foundation principle of the generator.

The quantity of current induced in this wire will depend upon the number of magnetic lines of force it cuts through per second. Two things decide what this number will be. The stronger the magnet, the more lines of force exist in its field; and the faster the wire moves, the more of these it crosses.

The fundamental law of physics that you cannot produce energy without expending energy applies here, of course, as it does in all machines and processes. For the stronger the magnet and the faster you try to move the wire through its field, the more resistance you encounter to that motion. How the current induced in the wire sets up a force that tends to thrust the wire back is explained in the Electricity article.

In this connection a fact should be noted here that will be usefully remembered in connection with many electrical phenomena. It is evident that if the wire W–E were stationary in the magnetic field no current would be induced in it. But if a current from some *outside source* were then passed through it in the direction of the white arrow, this current would set up a conflict of forces that would tend to push the wire out of the field toward the near side. In one case the motion of the wire produces a current and in the other case a current produces a motion of the wire.

Current Induced in Rotating Loop

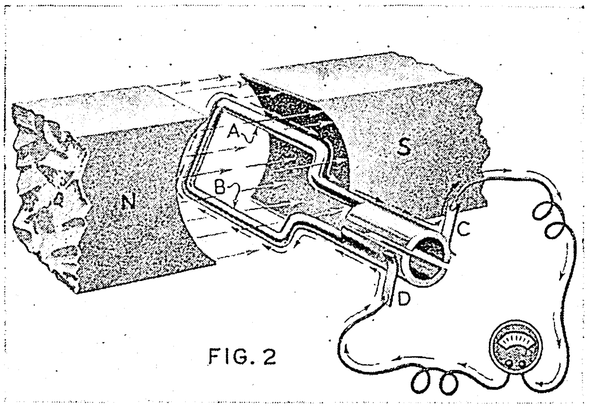
The next step in the development of an electric generator after Faraday's discovery was to devise a method of moving a wire continuously through a magnetic field so as to provide a steady supply of induced current. The problem was essentially simple, as Fig. 2 indicates. Here we have a loop or *armature* rotating in a field. The direction of rotation in the picture is assumed to be clockwise, so that the upper side A of the loop is just starting down across the magnetic field, while the lower side B is just starting upward. Since the two sides are moving across the magnetic field in opposite directions, the current in each will be opposite. In B it will flow toward the back, in A toward the front of the loop. But, of course, so far as the electrical circuit is concerned, these two currents are in the same direction, the one through B passing up and around the back end of the loop so that when it reaches the side A it is moving in the same direction as the current induced there.

It is evident that if the loop were a continuous unbroken ring, current would flow around it uselessly. To allow the current to be collected, the ends of the loop are formed into half cylinders with a gap between them. From these half cylinders, which form what is called a *commutator*, the current passes by sliding contact to the *brushes* C and D.

Current in Loop is Alternating

The purpose of the commutator is not only to collect the current from the loop, but also to keep it flowing always in the same direction. The need for this is obvious. For the current in the loop itself reverses its direction twice in each rotation. Consider the side A of the loop, for example. The current moves through it in the direction indicated by the arrows only when it is passing *downward* through the field. When it reaches the bottom of its swing, crossing the vertical plane between the poles of the magnet, and starts *upward* through the field, the current in it will, of course, take the direction now shown in the side B. If it were still connected to the brush C, the current through that brush, and hence through the entire circuit, would be reversed. But just as it passes the vertical plane, A's half of the split commutator slides out of contact with brush C and into contact with brush D. At the same instant, of course, B's half of the commutator breaks connection with D and makes contact with C. Thus the contact in the outer circuit

ESSENTIAL MECHANICS OF A GENERATOR



The chief parts of a direct-current generator are the field magnets (N and S), the armature (AB), and the split cylinder, called the commutator, from which the brushes (D and C) collect the current. Light arrows show the direction of the magnetic lines of force; black arrows the direction of the current through the outer circuit, containing an ammeter.

SIMPLE GENERATORS FOR ALTERNATING AND DIRECT CURRENT

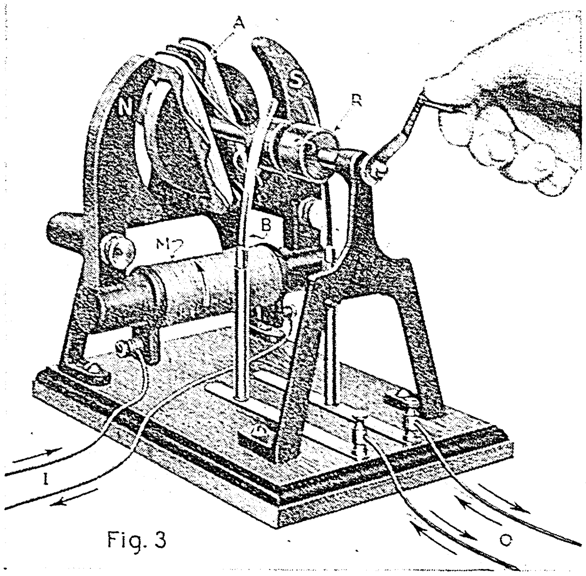


Fig. 3

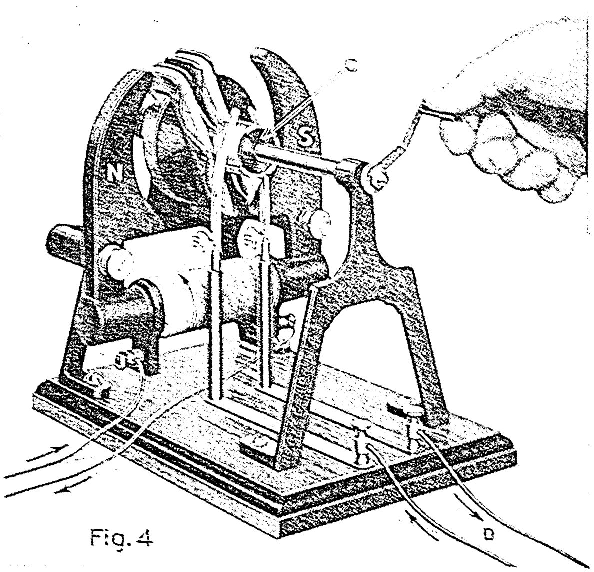


Fig. 4

The magnetic field in Fig. 3 is produced by an electromagnet. The current for this magnet enters and leaves through wires I. Its direction around the coil (M) is such as to make the left side of the pole piece (N) the north pole and the other side the south pole. Instead of the commutator shown in Fig. 2 and in Fig. 4, it has two slip rings (R), connected to the two ends of the coil of wire wound around the armature (A). Thus the alternating current induced in the turns of that coil by the rotation of the armature reaches the outer circuit without interruption through the brushes (B). The current changes direction each time the armature coil reaches a vertical position; that is, twice in each rotation. Two alternations constitute a cycle. In Fig. 4 everything is the same as in Fig. 3, except for the commutator (C) and the position of the two brushes (B_1 and B_2).

continues always to flow in the direction shown by the arrows. The current obtained in this manner is called a *direct current* (abbreviated D.C.). For many purposes, as we shall see, it is neither necessary nor desirable to turn the output of a generator into direct current. The *alternating current* (A.C.) naturally produced by the generator is permitted to flow back and forth in the outer circuit.

Armatures and Magnetic Fields

The single loop used for the sake of clearness as the armature in Fig. 2 would produce only feeble currents even if revolved at great speed. The armatures of practical generators consist of many turns of insulated wire wound around iron cores. The induced current is proportional to the number of turns, since each turn forms a loop in which a certain amount of current is generated more or less independently of the other turns. The iron core concentrates and increases the lines of force that pass across the armature.

In certain small generators called *magnetos*, the magnetic fields are produced by permanent magnets. For generating large currents, however, stronger fields are needed, and these are obtained by using electromagnets. The construction of simple laboratory generators embodying iron core armatures and fields produced by electromagnets is shown in Figs. 3 and 4. Both pictures should be examined carefully. Fig. 3 illustrates the principle of an alternating-current generator or "alternator." In Fig. 4 we see the commutator action that yields a direct current. The current that "excites" the field magnets of A.C. generators is derived from an independent source of electricity. Direct current generators, however, usually derive this field current from their own output.

The Electric Motor

Suppose that, instead of turning the handle of the generator in Fig. 4 and taking a current *out of* it through the wires D, we feed a current from some independent source through those wires *into* the machine in the direction indicated by the arrows. With the armature in the position shown, the left side of its core will become the north pole of an electromagnet. (The rule for the polarity of electromagnets is explained on page 228 of this volume.)

At once we see that this north pole of the armature will be repelled by the north pole of the field magnet, while the south pole created at the other side of the armature will likewise be repelled by the south pole of the field magnet. For we know that *like* poles of magnets always repel each other. The force of this repulsion will *set the armature in motion*. It will start revolving. Of course, the repulsion between like poles is supplemented by the attraction between *unlike* poles, and the armature will keep revolving in an effort to bring its north pole in line with the south pole of the field magnet and its south pole in line with the north pole of the field magnet.

But just as this line-up is reached, the action of the commutator reverses the current in the armature windings. What had just been the north pole of the armature suddenly becomes the south pole and vice versa. Its momentum carries it past this dead center and the reversed forces of attraction and repulsion send it on around to its former position,

where the commutator again reverses the current, and so on indefinitely. Our generator has turned into an *electric motor.*

The alternating-current generator shown in Fig. 3 can also be run as an alternating-current motor, provided it is set going by hand until its revolutions per second equal the cycles of the alternating current that is being fed into it.

Commercial Generators and Motors

Direct-current generators with only two poles produce currents of fluctuating strength, since at the top and bottom of their rotation the wires of the armature are not crossing magnetic lines of force. On the other hand, bipolar A.C. generators would have to be revolved at tremendous speeds to produce the 60 cycles per second required to avoid flicker in electric lights. For these and other reasons, commercial generators are usually made with four, six, eight, or even more poles as field magnets. These are arranged radially like the spokes of a wheel. Similarly armatures are wound with a large number of separate coils spaced evenly around the core. For D.C. generators, each of these coils has a separate connection to a pair of segments on the commutator (Fig. 5). The armatures of A.C. generators often carry two or three coils for each field magnet. These extra coils are connected so as to form a second or a third extra induction circuit and the generator then produces in effect two or three separate alternating currents, each "lagging" behind the other. Such generators are called respectively *two-phase* and *three-phase* alternators. The currents they produce are carried on three wires, the circuits consisting of wires 1 and 2 for the first phase, wires 2 and 3 for the second phase, and wires 1 and 3 when there is a third phase to be carried.

CONSTRUCTION OF STANDARD ARMATURE

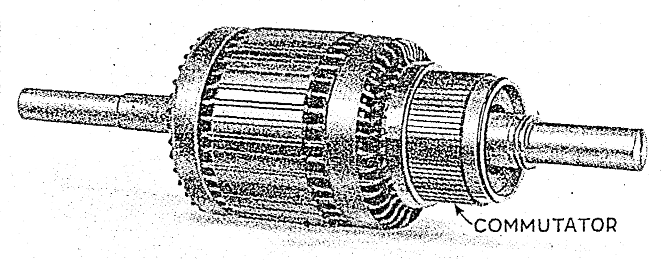


Fig. 5. This is the rotating part of an electric motor. Numerous coils are wound lengthwise around the grooves in the core. Each coil is connected to two of the many segments that form the commutator. This type of armature is said to be "drum-wound."

The Induction Motor

Phase circuits are used to run *induction* motors, the most generally useful of all types. The field coils of a two-phase induction motor are divided into two separately connected sets spaced at alternate intervals around the field. It is evident that, as the two currents, one lagging behind the other, pass through the two sets of coils, the polarities of the field magnets reverse in rotation, producing what are called *rotating magnetic fields.* The armature, or *rotor,* of such a motor does not, therefore, require outside electrical connection to activate it. It usually consists merely of bars of copper set into copper end plates forming a "squirrel cage." The rotating fields induce heavy currents in these bars. But, as we saw earlier in this article, a magnetic field resists the motion of a conductor through it. In this case, it is the field that moves across the conductor, but the effect is relatively the same. The result is that the rotating fields, opposing the motion of the copper bars through them, drag those bars around with them.

Suitably designed induction motors will run on single-phase circuits, once they get up to standard speed, so that the bars of the rotor can keep in step with the alternations of polarity in the field magnets. Such motors usually are started by means of commutators and auxiliary windings on the armature similar to those of the older type of motor; then, as the armature gathers speed, the auxiliary devices are disconnected automatically by a centrifugal switch. The common household motors are of this type.

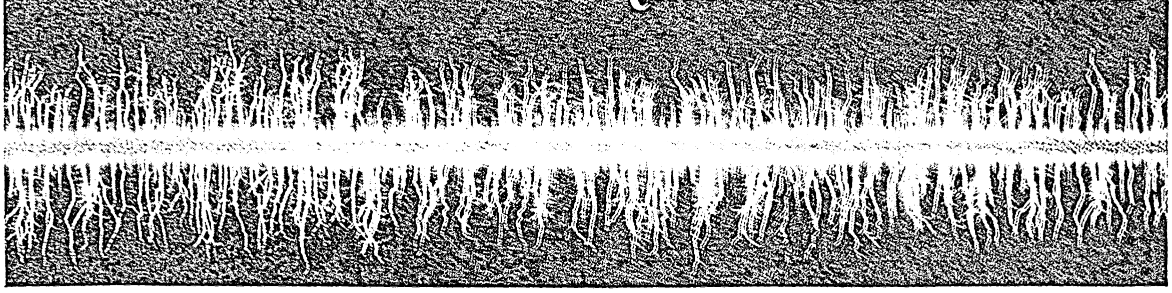
Simplest of induction motors is the one that runs an electric clock. The armature consists only of a metal plate with short projecting arms. Currents are induced in these arms by the alternations of the field magnet. Once started, the armature revolves at a fixed rate (*see* Watches and Clocks).

Losses of power in electric motors are due largely to *eddy currents* set up by induction in the solid metallic parts of the machines, particularly the core of the armature. An eddy current, as its name indicates, is a sort of electrical whirlpool formed when a current revolves around through paths of low resistance inside a piece of metal. To minimize them cores of motors and of transformers (*see* Transformer) are usually made of thin sheets of iron lying side by side but insulated from one another. A useful application of eddy currents is found in electric meters, where an aluminum disk revolves in the field of a permanent magnet. The eddy currents induced in the disk tend, according to our earlier rule of opposition, to check or "damp" the speed of revolution. Eddy currents are responsible also for the action of a speedometer. (*See* Meters; Speedometer.)

How an Electric Bell Works

The electric bell is in substance a type of electric motor. It consists usually of a pair of coils forming an electromagnet and of an armature consisting of a flat piece of iron fastened to a spring arm which holds it close to the poles of the magnet. The clapper in turn is fastened to this armature. One of the connections to the instrument is through a point of metal in contact with the spring arm, which is in turn connected to the coils of the magnet. When the bell button is pressed, closing the circuit, the magnet draws down the armature; but this immediately breaks the connection between the spring arm and the contact point, so the armature springs back, only to be drawn down again by the renewed contact at the spring arm. This produces a continuous and rapid vibration of the clapper against the bell as long as the button is pressed.

The "FIRE OF HEAVEN," Man's FRIEND and FOE



Have you ever seen an electric current? It is safe to say, you have not; but the photographic plate can "see" it when the current is of the "high-tension" type. That is, it can register the almost invisible "leaks" from a highly charged wire, as this picture shows.

ELECTRICITY. It used to be the custom to say that electricity was something very mysterious. The common remark was: "We know some of the things electricity *does*, but no one knows what it *is*." There are those who still talk and write about it in that way, giving the subject a reputation for difficulty which it no longer deserves.

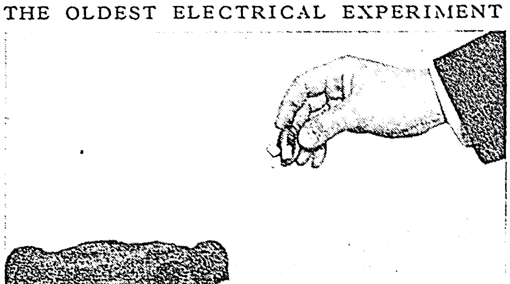
Of course, there are still many things we do not know about electricity, and there are numerous electrical theories and technical principles that cannot be understood completely without special training in physics and mathematics. But nearly all the most important, the most interesting, and the most practical facts about electricity are simple. With the aid of a few experiments, let us see if we cannot start with a fairly clear idea of what electricity is.

A Few Simple Experiments

If you stroke a cat's back in dry, cool weather, you feel little electric sparks under your hand. If you shuffle your feet over a carpet and touch another person or some metal object, a small spark jumps from your finger. If you rub a glass rod with a piece of silk, or rub with a woolen cloth a rod of hard rubber or similar substance (a stick of sealing wax or the barrel of a fountain pen will do), you can pick up with them little bits of paper or straw or pieces of thread.

The results of these first experiments are plainly seen. For the next ones, you will require a sensitive galvanometer to detect the electrical effects. You can find such an instrument in any school laboratory and check your own results; or you can simply take the word of science that they actually do take place. These results are illustrated on the next page, without showing a galvanometer, but the following descriptions tell how to connect the instrument, if you have one at hand.

THE OLDEST ELECTRICAL EXPERIMENT



This shows how a piece of amber rubbed on fur will attract bits of paper. The ancient Greeks observed this fact, using pieces of straw, for, of course, they had no paper. Neither did they have the idea of electricity to explain what happened. But when William Gilbert in the 16th century started to study the mysterious force, he named it from "elektron," the Greek word for amber.

The simplest of the experiments is done with an ordinary horseshoe magnet. Fasten a loop of wire to the galvanometer and then pass the loop between the poles of the magnet. The needle of the galvanometer moves, showing that a current is generated.

Now solder the end of an iron wire to the end of a copper wire, connect the other ends of the wires to the galvanometer, and then heat the soldered joint. Again the galvanometer indicates a current.

Connect with wires to the galvanometer a plate of copper and a plate of zinc. Dip the two into a weak solution of sulphuric acid. Once more, the needle of the instrument will show that a current is flowing.

What do these experiments suggest to you? You have seen electrical effects produced by friction, by magnetism, by heat, and by chemical reaction. All sorts of materials from cat's fur to corrosive acid have yielded electricity. If you had the apparatus, you could prove to yourself that electricity can be drawn from the surface of a metal by a beam of light. And you know from common observation that it seems to be made "out of thin air" by the forces that set up thunderstorms.

Moving Electrons "Make" Electricity

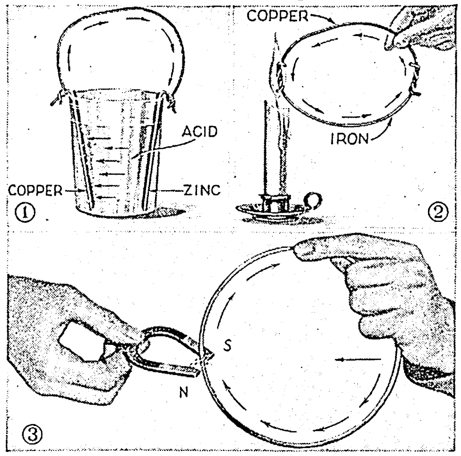
Learning these facts for the first time, you might say that almost everything seems to contain electricity and that the electricity appears to lie there quietly until something comes along to stir it up and move it around. This would be very near the truth. It was what scientists believed for a long time. The difficulty lies in that word "contain." No one could explain exactly what it meant. Did matter contain electricity, as a sponge contains water? Then electricity must itself be a separate kind of fluid matter. But this amounted to inventing a bigger mystery than the one already in hand.

Finally scientists hit upon an explanation that fitted the facts so well and proved so fruitful in uncovering new

facts that it has been universally adopted. Electricity, they said, is not *in* matter; it is a *part of* all matter. It consists of tiny particles called *electrons*, incorporated in the structure of every atom of every element of which the universe is made. The fundamental nature of electrons, in so far as science has formulated theories about them, is discussed elsewhere (*see* Atoms and Electrons.) Here we are concerned only with their behavior.

Under neutral conditions, these electrons remain attached to their respective atoms—held there by the attraction of the *protons* which form the center or nucleus of every atom. But when disturbed by energy from some outside source, some of the electrons may leave and wander to other atoms. This migration of electrons is what we call an electric current. Some atoms, like those of metals, for example, transmit electrons freely, and we say they are good *conductors* of electricity; others oppose the passage of the wanderers, and we speak of them as *non-conductors* or *insulators*.

THREE WAYS OF MAKING A CURRENT



As the text on the previous page tells us, an electric current can be set in motion by chemical action 1, by heat 2, and by magnetic action 3. The first of these methods is explained in detail on page 225 of this article, the second on page 226, and the third on page 228. The arrows show the direction of current.

Now any atom that has lost a part of its electron quota is in an unbalanced state; it will recover the electrons it lacks from any available source. Similarly, an atom that has acquired more electrons than it needs for its perfect balance will discharge them at the first opportunity. An atom with less than its quota of electrons is said to have a *positive charge* and one with a surplus of electrons is said to have a *negative charge*.

An electric *circuit* is simply a path composed of atoms of sufficiently good conducting properties so that electrons, torn loose at one point by the application of outside energy (friction, magnetism, heat, or chemical action), can travel around and return to fill the places left vacant (positive) by their departure. It is hard to say whether the electrons that start the journey go all the way to the finish, or whether they merely bump electrons off the atoms ahead of them and so pass on the motion, as in a relay race. Since the result would be the same in either case, it is simpler to describe their movement as a continuous passage. If there is no connected path over which this passage can take place; or if the intervening atoms strongly impede their movement, the electrons accumulate at points as close as possible to where they would like to go and form what is called a *static charge*.

What Positive and Negative Mean

Before going further, strong emphasis must be put upon the fact that the terms *negative* and *positive* as used in electrical science are purely relative terms. A body containing excess electrons is negative not only in respect to a body that has too few electrons, but it is negative as well toward a neutral body, and indeed, is negative also toward a body which has *fewer* excess electrons than itself. Similarly, if both bodies have a deficiency of electrons, the one with the *least* deficiency is negative with respect to the other. Of course, all these relations can be described equally well in terms of positive differences.

Difference of Potential

To sum up in concrete terms, whenever they can find a path electrons will flow *from* any spot where they are relatively numerous (negative) *toward* any spot where they are relatively scarce (positive). To understand this relativity of negative and positive is of fundamental importance, because the force that impels electric currents to move from one place to another depends entirely upon the *difference* in the concentration of electrons in the two places, or *potential difference*, as it is technically called.

When you shuffle your feet over a carpet, you rub off, as it were, some of the electrons from the atoms that compose the carpet and these accumulate in your body. You become negatively charged to such a degree that the electrons will jump from your finger in a spark when you bring it close to some neutral object.

Why does the friction loosen the electrons from the carpet's atoms instead of those from the soles of your shoes? In fact, it loosens both, but far more from the carpet's fibers than from the shoe leather. Substances vary greatly in the way they grip their electrons.

Attraction and Repulsion of Charges

When you rub a hard rubber rod with a woolen cloth, the cloth gives up electrons to the rod. These accumulate on the rod because it is such a poor conductor that they cannot easily run through it into your hand. But, unable to move about freely themselves, they exert their force just the same, the attraction between them and the neutral atoms in a bit of paper being sufficient to move the whole paper toward the rod. This illustrates what is meant by the saying that "unlike electric charges attract each other." In this case, according to the relative meaning of positive and negative which was explained above, the neutral charge in the paper is considered "positive" and therefore "unlike" the charge in the rubber rod. Proof of this relative nature of charges is easy. If instead of rubbing hard rubber with wool, you rub a glass rod with silk, electrons flow out of the glass and into the silk, leaving the rod *positively* charged. Yet it will pick up bits of neutral paper just as well as

the rubber rod did with its negative charge. In this case the neutral paper is relatively "negative."

The fact that "bodies with like charges repel each other," even though one charge is very weak and the other very strong would seem at first to be a contradiction of what was said about the tendency of electrons to flow from a place of higher concentration to a place of lower concentration. But this contradiction is only apparent. Electrons dislike one another's unmixed company, and every free electron repels every other free electron to some extent. Those in the weakly charged body do not want any more companions than they already have; neither do those in the strongly charged body. So each group of electrons will repel the other. But if a connection is made between them, those in the more closely crowded body will flow into the less crowded body until there is approximately even distribution. You can compare the situation to two rubber balloons filled with air, one under high pressure, the other under low pressure. If you push them together, each will tend to thrust the other away, resembling the repulsion of the electron charges. But if you connect them with a tube, air will flow from the high-pressure balloon to the other until the pressures in the two are equalized.

The Direction of Current

A great deal of confusion will be avoided, if we clear up at the outset a conflict in terms about the direction in which electric currents flow. In the early days of electrical science, investigators believed that there were two kinds of electricity—the kind generated in a glass rod when rubbed with silk which was called "vitreous" electricity; and the kind generated in a rod of rubber, sealing wax, amber, or similar substance when rubbed with wool, which was called "resinous" electricity. Benjamin Franklin was the first to propose that they be called respectively "positive" and "negative" electricity. From then until the time of the discovery of electrons, it was assumed that the direction of flow of an electric current in a conductor was from positive to negative. We know today that the electrons which constitute the current are negative particles in the old sense of the word, and that when they flow they necessarily move toward relatively positive areas. But the old assumption has become so firmly imbedded in scientific and engineering parlance that we still say, for instance, that electricity flows from the positive pole of a battery to the negative pole, although the electrons are actually moving in the opposite direction. No harm results from this old convention, provided it is understood that in virtually all books and discussions "direction of current," unless otherwise qualified, means from positive to negative. Only when electrons are specifically mentioned is it customary to take account of their opposite movement.

We now have before us the essential facts about the nature of electricity, in so far as they are needed to explain the practical phases of its behavior. We can turn our attention to some of the things that happen when streams of electrons are set in motion.

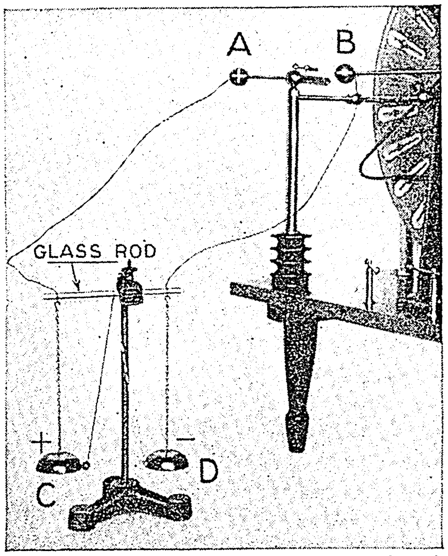
Electrical Resistance

Scientists are not certain why some substances are conductors and others insulators. The theory most widely held is that the difference is probably related to the firmness with which electrons are bound in fixed positions inside the structure of the substance. In metals like copper, for example, the arrangement is believed to be such that some of the electrons belonging to the atom are more or less free to pass on from one atom to another. But even so, as the electrons move from atom to atom in a copper wire, they encounter resistance, very much like friction, which consumes some of their energy. This resistance varies with temperature, usually decreasing as the temperature lowers, so that at the same potential a cold wire will transmit more electricity than a hot wire.

The term *resistance* is usually applied to a definite circuit or part of a circuit. But when engineers discuss the degree to which various substances oppose the passage of electricity, they employ the terms *specific resistance* or *resistivity*. When the emphasis is to be put upon the ability to conduct current rather than upon the property of opposing it, the terms *conductance* and *conductivity* are used. The conductivity of copper is generally adopted as a standard of comparison. If this is assumed to be 100, then silver rates at 104, gold at 70, and aluminum at 64.5. These four metals are, under ordinary conditions, the best conductors among all the earth's materials.

Even those substances which are classed as nonconductors allow some electrons to pass when the potential is high enough; but they earn the name of insulators if they keep this leakage within practical bounds. Common insulators are vulcanized rubber, bakelite, paraffin, glass, porcelain, and mica.

FRANKLIN'S ELECTRIC CHIME



Positive and negative charges are transferred from the knobs A and B of the Wimshurst electric machine to the bells C and D. The clapper hanging from a silk thread swings first toward whichever bell happens to be slightly nearer, say the positive bell C. When it strikes C it receives a positive charge and so is repelled by C and attracted by D. From D, it receives a negative charge and swings back again to C. The ringing continues so long as the opposite charges on C and D are maintained. Benjamin Franklin invented this electrical toy.

The term *dielectric* is often used as if it were a synonym for insulator, but it really has a different meaning. It applies to the passage of spark discharges. A substance may be a good insulator in the sense that it will not conduct current, yet it may be a poor dielectric because a spark can break through it easily. Mica and glass, for example, are better dielectrics but poorer insulators than vulcanized rubber and bakelite.

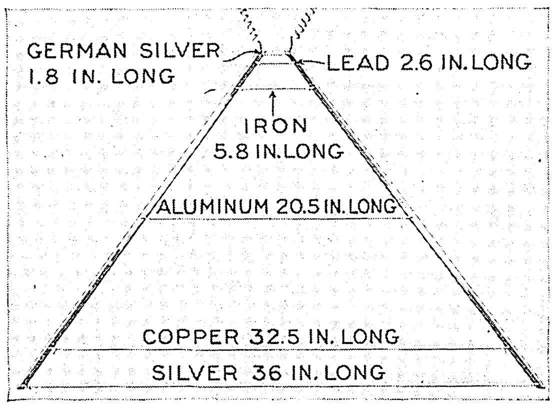
The Electron Flow in Circuits

Electrons do much of their work for us while they are moving through circuits; so it is of primary importance to know some of the rules that govern these circuit movements. We have seen that the difference in the concentration of electrons in two places, or potential difference, is what impels an electric current to flow between those two places. This potential difference is often called the *electromotive force* (abbreviated as E.M.F.), particularly when referring to the original force at the battery, dynamo, or other source of electric current.

Now the number of electrons, or as it is commonly expressed, the *quantity of current*, that will flow in a given time between the two places depends upon the resistance this force encounters along the path or circuit that joins the two places.

To describe exactly how electromotive force and resistance affect the rate at which current flows, we must define some practical units of measurement. It would be possible to use the electron itself as a unit, but it would be inconvenient. For example, the number required to operate an ordinary electric lamp of medium power is more than three billion billions per second! Instead, we define electrical units in terms of *effects* produced by an electric current. Any of its effects could serve as a basis, but by common consent the following definite chemical effect has been adopted as the practical standard of electrical measurement.

HOW METALS VARY AS CONDUCTORS



Each of the pieces of wire shown here has the same resistance as the other five. In other words, a German silver wire 1.8 inches long offers the same opposition to the passage of an electric current as a piece of true silver wire a yard in length. The wires are equally thick.

If an electric current is passed between two silver plates dipped into a solution of silver nitrate, then silver from the positive plate will gradually pass through the solution and deposit itself on the negative plate. For reasons that will be made clear later, the amount of silver thus transferred depends on the number of electrons passing through the solution. And the number of electrons (quantity of current) that will bring about a transfer of .0011181 grams of silver is the standard unit. It is called a *coulomb*, in honor of Charles Augustin de Coulomb, distinguished French physicist of the 18th century. That odd decimal part of a metric unit was chosen so that electrical energy could be readily converted into previously existing units of mechanical and heat energy. It is no more important to remember that figure or that definition than it is to remember that the standard of all measures of length, the meter, is defined as 1,553,163.5 times the wave-length of red cadmium light. But it *is* important to bear in mind that virtually all our units of measurement rest upon conventions of this kind.

Amperes, Ohms, and Volts

But we cannot describe the flow of a current in terms of quantity alone; we must know the rate of flow or *current density*. For this purpose we use the *ampere*, which is defined as one coulomb per second. This unit is named in honor of André Marie Ampère, another famous French physicist.

The unit of resistance is defined by international agreement as the resistance at a temperature of 0° Centigrade of a column of mercury exactly 106.3 centimeters long and weighing 14.4521 grams (this makes the cross-section of the column as nearly as possible one square millimeter). This unit is called the *ohm* in honor of Georg Simon Ohm, a famous German physicist.

With the unit of current flow and of resistance definitely settled, it is simple to define the unit of electromotive force. It is that force which will send a current of one ampere (one coulomb per second) through a resistance of one ohm. Its name is the *volt*, honoring Alessandro Volta, the Italian inventor of the electrochemical cell.

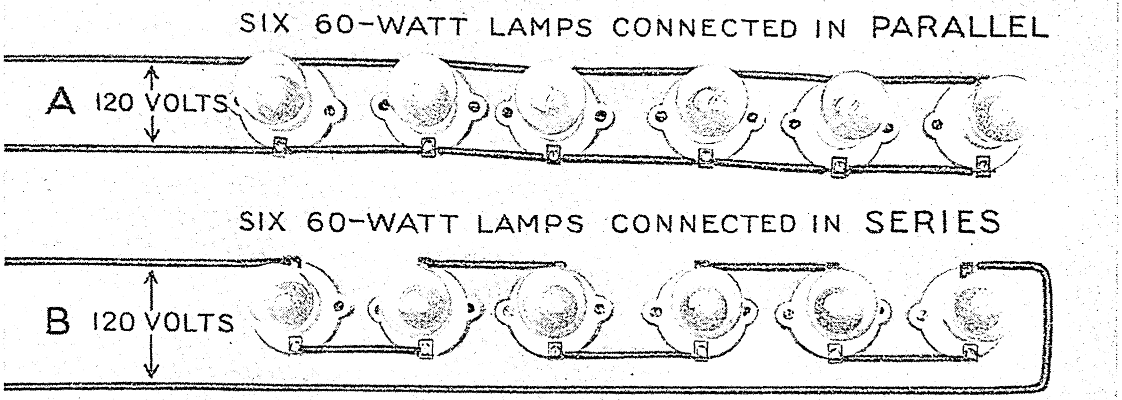
Out of these units is constructed the fundamental formula called *Ohm's law* for calculating any one of the three factors in electrical circuits when the other two are known. Using I to denote the current in amperes, E to denote the electromotive force or potential difference in volts, and R to denote the resistance in ohms, the following mathematical relations express this law:

$$I=\frac{E}{R} \qquad E=IR \qquad R=\frac{E}{I}$$

If you want to know, for example, how many amperes of your 110-volt house current will flow through an electric iron of 20 ohms resistance, you simply divide 110 by 20, and your answer is $5\frac{1}{2}$ amperes.

With Ohm's law as basis, a great many other formulas have been evolved by electrical engineers for computing factors in complex circuits. These are

APPLYING OHM'S LAW TO TWO SIMPLE PROBLEMS



IN the first problem A we have six electric lamps connected in "parallel" to a house circuit in which the light company maintains a steady voltage of 120. The parallel connection is universal for household fixtures and appliances, and it simply means here that each of our lamps is independently wired to the incoming and outgoing lines, so that the current it uses does not pass through any other lamp on the way in or out. This gives each lamp the benefit of the full voltage. Under this standard condition, the lamps we have selected will "draw" 60 watts of power. Can you figure from this the resistance of each lamp and the amperes that flow through it?

From our main text we know that watts used in any circuit are equal to amperes multiplied by volts; therefore amperes must be equal to watts divided by volts. So we divide 60 by 120, and find that $\frac{1}{2}$ an ampere is flowing through each lamp. From Ohm's law we know that the resistance of a circuit or any part of a circuit equals the voltage across it divided by the amperage: in this case, 120 divided by $\frac{1}{2}$, which gives us 240 ohms resistance for each of our lamps.

In problem B, six lamps of 240 ohms resistance are connected in "series." The current on its way in and out has to pass through each in succession. Therefore the resistance the 120 volts must overcome with this arrangement is the total resistance of the six lamps—6 times 240 ohms, or 1,440 ohms. The rate of flow or amperage, according to Ohm's law, will then be equal to 120 divided by 1,440, or $\frac{1}{12}$ of an ampere. Multiplying this by the voltage, we find that all six lamps together would only draw 10 watts of power, which would hardly produce a visible glow in their filaments. To burn these six lamps in series as brightly as the six lamps in parallel would require 720 volts.

mathematical short-cuts, employing symbols, terms, and conventions that are likely to confuse and mislead the layman who tries to interpret from them the concrete facts about the behavior of electric currents. Consider, as a simple example of this difficulty, the second equation, $E=IR$, on page 222. Those unfamiliar with its meaning might easily assume that you could increase the potential difference E in a circuit by increasing the resistance R without altering the current flow; which is, of course, absurd. This equation, like the others, merely tells you how the three factors must be and are balanced in a circuit *whenever a current flows.*

Interpreting the Law of Circuits

A summary of the concrete facts may help to clear up such difficulties. In every circuit there is available a definitely limited force (friction, chemical action, or other agency) which sets electrons free. In other words, the total number of electrons that this force can pump out into the circuit per second is limited. If the circuit had no resistance this maximum number would leak away as fast as produced, none would accumulate and there would be no such thing in that circuit as potential difference.

But under normal conditions all circuits have resistance. They will not permit to pass the maximum number of electrons that a given force can set free. So electrons begin to accumulate and the repulsion they exert on one another builds up a "pressure." As this pressure increases, more and more electrons flow through the resistance, but, on the other hand, fewer and fewer per second are set free; for the task of setting them free against the pressure grows harder. This continues (the whole taking only a tiny fraction of time) until the number of electrons that are set free each second exactly equals the number that are getting through the resistance. At that point the pressure remains fixed.

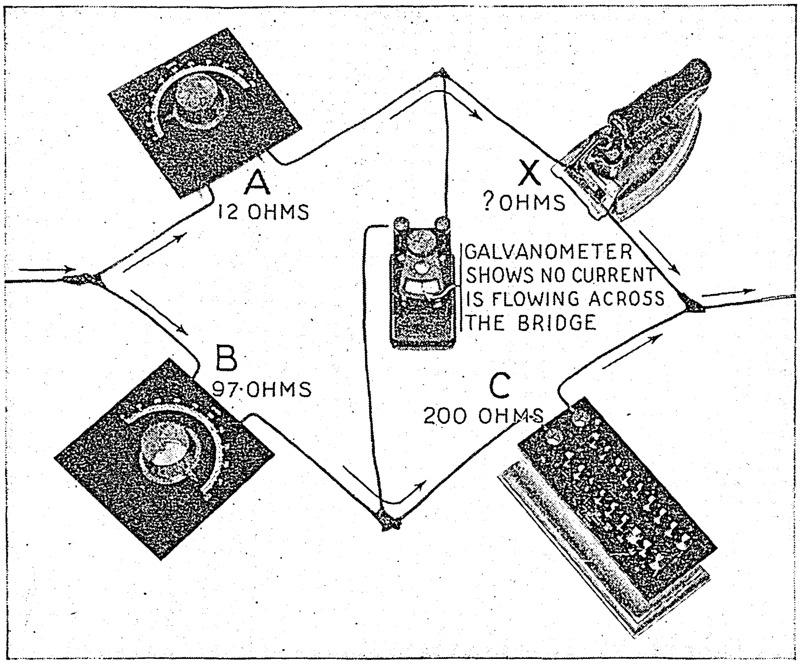
Now the pressure required to balance the pumping force against the resistance is the potential difference or *voltage* of the circuit; and the number of electrons that are flowing at an even rate in all parts of the circuit constitute the *amperage* or current density (commonly called simply the "current").

You may think of what happens in these terms: The force generating the current expends itself partly in overcoming the resistance of the circuit (thus building up the voltage), and what remains of that force is used

up in producing free electrons. It is evident that no more voltage is produced by the process than is exactly sufficient to drive those electrons through the total resistance of the circuit. So that whatever the voltage may be at the starting terminal, it always becomes zero at the return terminal.

The resistance of the circuit is not, of course, concentrated in one place but is distributed throughout the circuit, a small amount in the conducting wires, larger amounts in the apparatus or other working devices; for it is an axiom of electrical action as it is of mechanical action that where work is done, a proportional amount of resistance must be overcome. In overcoming each item of resistance in the circuit, the current loses a definite part of its voltage. This is often called in technical descriptions of electric circuits the "voltage drop across" that item, or simply the "voltage across" it.

MEASURING RESISTANCE WITH A WHEATSTONE BRIDGE



The famous bridge circuit, shown here in practical application, is one of the most accurate methods for determining the electrical resistance of an object. The object here is an electric iron X. This is connected, as you see, with three variable "resistors" or "rheostats" A, B, and C, to any moderate source of direct current. Across the middle of the bridge is wired a galvanometer of the type that will show current passing in either direction, like an automobile ammeter. The variable resistors are carefully adjusted until the galvanometer needle stands at zero, showing that no current is passing through the middle wire. This tells us that the voltage drop across A is the same as that across B, and that the voltage drop across X is the same as that across C. We know, on the other hand, that the amperes through A equal those through X, since no current flows across the bridge; similarly that the amperes through B and C are the same. Applying Ohm's law formulas, and canceling out equal voltages and currents, we reach the conclusion that the ratio of the resistance of A to the resistance of X is the same as that of the resistance of B to the resistance of C. The ratio of 97 to 200 is 2.06. Multiplying 12 by 2.06 gives us 24.7 ohms as the resistance of the iron. The resistor C is adjusted by pulling out one or more of its plugs; the other two resistors are of the revolving contact type.

No electrons are ever "lost" in a circuit. The number that leaves one terminal of a generator of current is always equaled by the number that reaches the other terminal. It is only their voltage that is used up. But we must not assume on that account that the voltage in a circuit is alone a measure of the *power* in that circuit. You must know also how many electrons per second or amperes are pushing through that circuit. The electrons do the real tangible work in the circuit; but in order to do it, they must be moving. The voltage provides that motion and nothing else.

The Watt, Unit of Power

Thus electrical power is defined as *the product of the current density and the potential difference*. The standard unit of electrical power is the *watt*, named in honor of James Watt. To find the watts of power that are passing through a circuit or device we *multiply the amperes by the volts*. The various kinds of instruments for measuring volts, amperes, and watts are described in the article on Galvanometer.

The proportion of amperage to voltage in a circuit can be altered by devices which will be described later, but the product of the two must always remain the same, unless more power is applied to the production of electrons at the source. From the same battery, an automobile derives currents of extremely high voltage (from 8,000 to 15,000 volts) but of relatively low amperage for delivery to the spark plugs of its engine, and currents of low voltage but extremely high amperage for driving the starting motor.

Electricity is commercially supplied by power houses at fixed voltages. These voltages are maintained by suitable controls which increase or decrease the power applied to the electric generators as more or less current is drawn from the supply lines by the users. For domestic use 110 to 120 volts is customary, though some cities are supplied with current at 220 volts. The resistance of all devices, lamps, motors, heaters, etc., must be adjusted so that the standard voltage will drive through each device the current it requires for proper operation. A lamp designed for a 110-volt circuit will let through so much current on a 220-volt line that the filament will burn up. On the other hand, a lamp designed for 220 volts will shed only a feeble glow if it is connected to a 110-volt line.

Electricity and Solutions

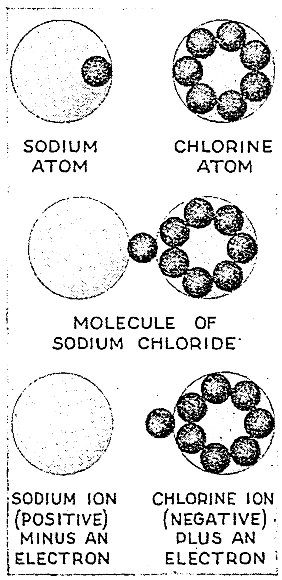
One of the first experiments described in this article showed us that an electric current can be produced by dipping two metals into an acid solution. The whole field of the electrical behavior of chemical solutions is

an extremely interesting and important one which is surveyed in the article on Electrochemistry. Here we need to consider only those principles that will help us to draw a contrast between solutions and solids as generators and conductors of free electrons.

We will take our original example, involving copper, zinc, and sulphuric acid. Before the metals are put into the solution, the sulphuric acid (H_2SO_4) is already partly *dissociated.* This means that some of the hydrogen atoms and sulphate particles (SO_4) that make up the molecules of the acid have broken apart, a common result of dissolving chemicals in water, as the neighboring illustration shows. But the break between hydrogen and sulphate is, under such conditions, not a simple clean-cut break. For certain reasons growing out of chemical valence or affinity (*see* Chemistry), each sulphate particle runs off with two electrons belonging to the two hydrogen atoms with which it was previously associated. Those two excess electrons constitute a negative charge, and in that condition we call the sulphate particle a sulphate ion and express its charge with the symbol SO_4^{--}. On the other hand, each of the hydrogen atoms, having lost an electron, has become a positively charged hydrogen ion, with the symbol H^+.

These negative and positive ions are continually recombining and dissociating again in the solution, but at any given moment there are always equivalent quantities of each, so that the solution as a whole is electrically neutral.

EVOLUTION OF IONS



The general principle of "dissociation" and transfer of electrons in solutions is illustrated here with a standard example. The outer "shell" of an atom of sodium is composed of a single electron; that of a chlorine atom consists of seven electrons. For reasons explained in the Chemistry article, when the sodium atom and the chlorine atom combine to form a molecule of common salt, the single electron from the chlorine seems to act as the binder between them. And when the sodium chloride molecule goes into solution and "dissociates," the chlorine keeps that electron and the two atoms become ions.

How Electrons Are Freed

Now let us see what happens when we put our plates of zinc and copper into the solution. As the article on Electrochemistry shows, metals vary greatly in their chemical activity, and this variation is closely associated with the readiness of their atoms to part with some of their electrons. Zinc is a much more active metal than copper, and when it comes in contact with the acid solution, quickly starts to dissolve in it. But the zinc atoms cannot go into solution with all their electrons; each atom must leave two electrons behind and so become a positively charged zinc ion (Zn^{++}). No sooner does this happen, however, than some of the zinc ions encounter some of the negatively charged sulphate ions and promptly combine with them to form neutral molecules of zinc sulphate—a combination that sticks together in the solution much more tightly than the original one between the hydrogen and the sulphate.

The net result of this chemical reaction is that the abandoned electrons accumulate on the zinc plate producing there a negative charge, while the neutralization of some of the sulphate ions in the solution itself leaves there a preponderance of hydrogen ions, constituting a positive charge.

You may ask why the electrons on the zinc plate do not flow back into the solution since the latter is positive. Because the interplay of chemical forces that set those electrons free maintains a definite barrier, like the action of a pump, dividing the negative and positive areas. A one-way action of this type must necessarily exist wherever and whenever an electric current is generated. Presently, however, what we may call the "back pressure" of the accumulated electrons on the zinc plate grows until it balances the chemically generated forward force; zinc ions can no longer break loose from the plate, and the system comes to rest.

In the meantime no such activity takes place at the copper plate. The greater tenacity of copper for its electrons, coupled with the increasing positive charge of the solution itself, prevents positive copper ions from forming.

Releasing the Electron Flow

The next step is to see what happens when we connect the zinc plate to the copper plate with a wire. The accumulated free electrons will, of course, flow from the zinc plate through the wire and down to the copper plate. There they immediately attract the positively charged hydrogen ions. As soon as these ions touch the plate, each one collects an electron and turns into a neutral hydrogen atom. These atoms form into gas bubbles, rise to the surface, and pass out of solution into the air. This removal of electrons partly relieves the pressure at the zinc plate, leaving only what is due to the resistance of the wire; whereupon the chemical action starts up again, and a steady electric current flows.

All electric *cells* and *batteries* operate in this or in some similar way. The metals used for terminals may differ and the solutions may differ; the chemical action may be a reversible one, so that cells may be "recharged" when they have run down, as in the case of storage batteries; but the principle is always the same—a roundabout exchange of electrons between two substances, brought about by the net difference between the forces of two or more chemical reactions. This net difference is used up in moving electrons around the circuit against whatever resistance they may meet. This explains why the voltage of a cell is always limited. A large cell will yield a greater *number* of amperes than a small one, but its potential difference can never rise beyond the point where its pressure halts the chemical action. Useful as batteries are, if we had

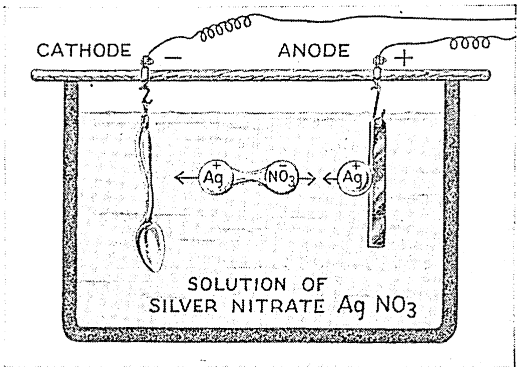
been compelled to rely solely on chemical action for our supply of electric power, electricity would never have transformed our civilization as it has done. (*See* Electric Battery; Storage Battery.)

What Electrolysis Means

We have just seen how chemical action in solutions produces an electric current. Let us now examine the reverse process, namely how a current, generated independently, will produce chemical action when it passes through a solution. This process is called *electrolysis*. The conductors that dip into the solution are called *electrodes*, instead of terminals, the negative electrode being the *cathode* and the positive electrode the *anode*. The solution is the *electrolyte*.

As a type of all electrolytic action, we may consider the example already cited in defining the coulomb. Here two silver plates are immersed in a solution of silver nitrate ($AgNO_3$). The silver nitrate, like the sulphuric acid in the case of our cell, is partly dissociated in the solution before any current is applied. It forms positive silver ions (Ag^+) and negative nitrate ions (NO_3^-). Notice that the single plus and minus signs indicate that only one electron has changed hands in this ionization, instead of two as was the case with the formation of the zinc and sulphate ions. This illustrates merely a difference of chemical valence, and has no effect whatever on the general principles under discussion.

SILVER PLATING A SPOON



The rod across the top of the tank is made of wood or other non-conductor. The bar of silver is connected to the positive terminal of a battery, the spoon to be plated to the negative terminal. The accompanying text tells what happens in the solution when two silver plates are used. The substitution at the cathode of a spoon of some other metal than silver does not alter the action in any important sense. For technical reasons, commercial silver plating is done with a solution of silver cyanide instead of silver nitrate.

As soon as a source of electric current is connected to the two silver plates, the positive silver ions in the solution move toward the negative or cathode plate, where each acquires an electron. This turns the ion to an atom of metallic silver which deposits itself on the cathode. Meanwhile the negative nitrate ions have migrated to the positive or anode plate, where silver ions break away to meet them, neutralizing their charge. The electrons left behind on the anode by these newly-formed silver ions travel around to the source of the current and there are "pumped" out again on the negative side down into the cathode, where they turn additional silver ions into a deposit of silver atoms.

In time, the anode plate is eaten away and an equivalent amount of silver is deposited on the cathode. Since the nitrate ions remain in solution, and a silver ion is produced at the anode for every one that goes out of solution at the cathode, the chemical composition of the solution itself undergoes no change.

It is easy to see, however, how this driving of electrons through solutions can be made to bring about a great variety of changes in solutions. The picture that heads the Chemistry article, for example, shows how water is decomposed into oxygen and hydrogen by electrolysis. The process for recovering aluminum from its ore, illustrated at the beginning of the Aluminum article is another application of the principle. (*See* Electroplating; Electrotyping.)

To plate an object which is a non-conductor, such as a plaster cast, it is first dipped into melted wax and then coated with finely pulverized graphite. This makes the surface a conductor. For copper plating, the anode is a copper rod and the solution is copper sulphate.

How Heat Makes a Current Flow

The relatively greater freedom with which electrons leave some metals than they do others accounts for the fact, observed in one of our preliminary experiments, that heat applied to the junction of a copper and an iron wire in a circuit will cause an electric current to flow. In the case of these two metals, the electrons pass across the heated joint from the iron to the copper. At ordinary temperatures electrons tend to flow from iron to copper when they are in contact, but a circuit made up of the two has, of course, a second junction of the metals where the electrons tend to flow from iron to copper in reverse direction, and the two tendencies neutralize each other. Heat at one of the junctions, increasing as it does the motion of the molecules of the metals (*see* Heat) seems further to loosen the electrons and to give them sufficient added impetus at that point to overcome the back pressure at the other junction. Although not practical for generating large currents, this action takes place with very small changes in temperature, and hence is applied to sensitive heat-measuring devices (*see* Pyrometer; Thermometer).

Virtually all electric effects are reversible. So it is not surprising to learn that if electrons from an external source of current are forced across the junction from copper to iron, the junction will become warmer than the rest of the circuit.

How Electricity Produces Heat

Most important, however, of all *thermoelectric* effects, as interactions between heat and electricity are called, is the general rise in temperature that takes place whenever a current flows through a conductor. The heat is due to the friction-like disturbance produced by the moving electrons. If you could measure the temperature of an ordinary electric lamp cord, you would notice a rise when the light is turned on. The filament of the lamp itself, which offers higher resistance, gets so hot that it glows.

Many types of electric heaters, from curling irons to giant electric furnaces, work on this principle. So do the electric fuses that prevent our house wiring from being "burned out" when a short circuit occurs. The term "short circuit" is applied to any connection in a circuit that permits the current to flow around an electrical device or piece of apparatus instead of passing through it. If the cord to a lamp or a flat-iron is worn bare so its two wires come into contact with each other, you have a short circuit. Since there is very little resistance in the wires alone, a tremendous current begins to flow which, if it were not shut off, would quickly heat the wires red hot, melt some of the connections in the walls, or perhaps set fire to the house. But all house circuits pass through fuses, usually grouped in a fuse box in the basement, and these fuses contain wires made of an alloy that melts at low temperatures (*see* Alloys). Before the sudden rush of current can do any damage, one of these wires melts and breaks the circuit.

It is worth remembering that the heat generated in a conductor of a given resistance increases as the *square* of the amperage. If you double the amperes, you quadruple the heat. This is why power companies transmit current at high voltages and low amperages. Less energy is dissipated in the form of heat. (*See* Electric Light and Power.)

Electricity and Magnetism

The relation between electricity and *magnetism* is one of the most fascinating aspects of science. It has made possible furthermore the lavish supply of electric power upon which modern life is so dependent.

In exploring this field the *direction of current* must continually be taken into consideration. So we must recall the conventional distinction, previously explained, between electron movement and current flow. Throughout the ensuing discussion "direction of current" will always mean from positive to negative—the reverse of electron movement.

In 1820 the famous Danish chemist, Hans Christian Oersted, proved that an electric current moving through a wire will affect a near-by magnet. The effect is definite and easily tested. Hold such a wire in front of you with your two hands, and let the direction of current be from your left hand toward your right. Now bring the wire close *above* a compass. The needle of the compass will at once set itself at right angles to the wire, and the north pole of the needle will be pointing *away* from you (Fig. 1). If you will now contrive to hold the wire in the same way *beneath* the compass, the needle will promptly turn around, so that its north pole is pointing *toward* you.

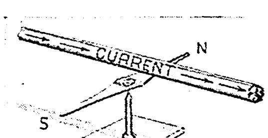


Fig. I

Compass needle shows polarity of electric current in a wire.

Examining a Magnetic Field

To understand the importance of this effect, we must have clearly in mind certain facts about magnets. By agreement among scientists the name *north pole* or *positive pole* is given to that end of a magnet which is attracted by the north pole of the earth. The other end is called the *south pole* or *negative pole*. The space surrounding a magnet throughout which its influence can be detected is called its *magnetic field*. And this influence is commonly described as being due to *lines of magnetic force* that traverse the field. The direction of these lines of force is assumed to be outward from the north pole and inward to the south pole.

Now whenever two magnets are brought near each other, so that their magnetic fields can interact, they tend to arrange themselves so that the lines of force in the two fields will be moving in the same direction. In other words, the north pole of one magnet will point in the direction in which the lines of force of the other magnet run. A moment's reflection shows that this is simply another way of stating the formal law that unlike poles attract each other, while like poles repel each other. (*See* Magnet.)

If we go back now to our electric current and compass, we see at once that when the current is flowing through the wire, it must be setting up around the wire lines of magnetic force to which the compass needle adjusts itself. From the way the needle points when the wire is above it, and from its reversal when the wire is below it, we know the direction of those lines of force. Perhaps the easiest formula to remember is that, *if you sight along a wire in the direction in which the current is flowing, the lines of force circle the wire clockwise* (Fig. 2). This is an extremely important rule.

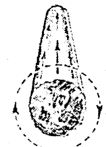


Fig. 2

Making a Magnetic Coil

The magnetic force at any point along a single wire carrying a moderate current is relatively feeble. But it is evident that if we can concentrate into a small space all the lines of force throughout a long wire, we can get a force great enough to be useful. This is easily accomplished by winding the wire into a coil. When this is done the lines of force, instead of remaining as small circles around each section of wire, tend to join together and form a large magnetic field circling the entire coil (Fig. 3).

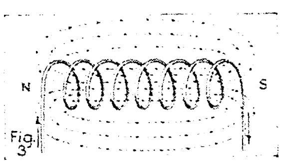


Fig. 3

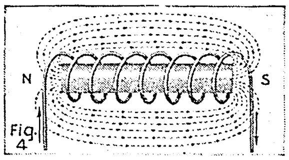
The dotted lines indicate the magnetic lines of force emerging from the north end of the coil, curving around it to form a single large field, and entering the south end.

The strength of the lines of force around a single wire depends upon the quantity of current (amperes) flowing through it. When the wire is wound into a coil of, say, 50 turns, the effect is much the same as if you had a single wire with 50 times the amperage flowing through it. The term *ampere-turns*, denoting the number of turns of wire in the coil multiplied by the amperes flowing through each turn, is used to describe the magnetic strength of such a coil.

It is evident that the arrangement of the turns in a coil will influence the distribution of the magnetic field. A common form for experimental purposes is called a *solenoid* (from the Greek meaning "tubelike"). It is usually wound on a cylinder of cardboard or bakelite and consists of one or, at most, a few layers of wire arranged like thread on a spool.

We said above that the magnetic lines of force around the individual turns of wire in a coil "tend to" join together to form a single magnetic field around the coil. But not all of them can succeed. Many of those emanating from the middle wires of the coil exhaust their strength and break down, so to speak, before they can complete the long journey around the

coil. This is due to the comparatively low *magnetic permeability* of air. The permeability of a substance for magnetic lines of force is something like the conductivity of a substance for an electric current. Soft iron is the most permeable in this sense of all ordinary materials. If we insert into the middle of our coil a piece of soft iron (Fig. 4), far more lines of magnetic force will become concentrated at the ends of the coil and throughout the entire field than before, because they encounter less resistance in traveling through the iron than in traveling through the air. The insertion of this iron "core" turns our magnetic coil into an *electromagnet*. Reversing the current in the coil reverses, of course, the polarity of an electromagnet. How the soft iron core responds almost instantly to this reversal is explained in the following paragraphs.



The increased number of dotted lines indicates the effect of the iron core. To determine the polarity of a coil, grasp it in the right hand, so the fingers point in the direction of current flow. The thumb will then be toward the north pole.

Magnetic Action of Iron Atoms

We have seen that the moving electrons which constitute an electric current generate magnetic lines of force. The atoms of all substances, according to the modern atomic theory, are surrounded by electrons traveling in orbits like the planets around the sun. Each of these moving electrons is believed to set up lines of force in its vicinity. But in all atoms except those of iron, nickel, and a few other "magnetic metals," the revolving electrons seem to follow such divergent paths that the lines of force they set up cancel one another. Those revolving around the iron atom, however, appear to be moving more or less in the same direction, and the result is to turn each atom into a tiny electromagnet.

In an ordinary piece of soft iron these atom-magnets are pointing in every possible direction, just as would happen if you threw a large number of small bar magnets down on top of a table. But when the piece of iron is put into a magnetic field, like that of our coil, the atoms straighten out along the lines of force and add their effect to the total. The accompanying pictures (Fig. 5 and Fig. 6) show models specially designed to illustrate this action. In soft iron the atoms are loosely packed and lose their regular magnetic pattern as easily as they acquire it. Those in the core of an electromagnet whirl end-for-end the instant the current is reversed. Hard steel, with its closely packed atoms, acquires magnetism less easily, but the effect is more permanent.

THE ATOM-MAGNETS IN A PIECE OF IRON

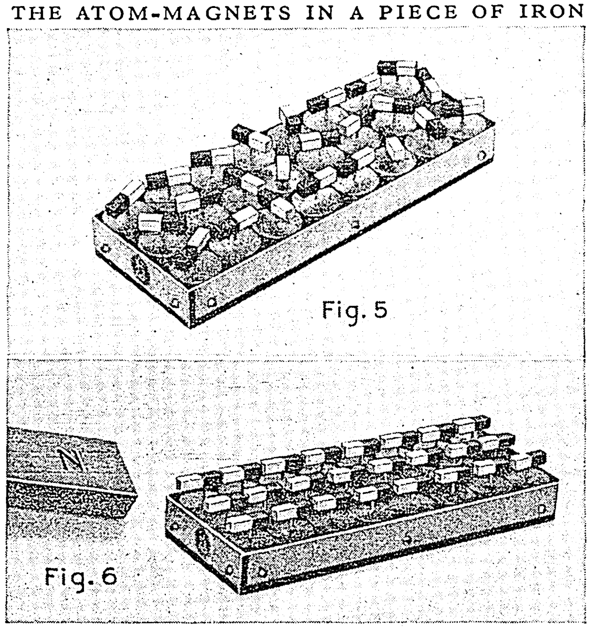


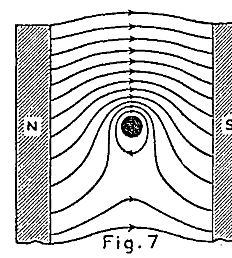
Fig. 5 is a model in which small magnets suspended on pivots represent the atoms in an unmagnetized piece of soft iron. They point, as you see, in random directions. Fig. 6 shows the effect of a magnetic field on the piece of iron. The atoms line up, their south poles toward the north pole of the big magnet. In this condition the piece of iron becomes itself a magnet.

How Magnets Produce Currents

We have just seen how an electric current can be used to produce a magnet. At the beginning of this article we saw that a magnet can in turn produce an electric current. Let us examine briefly the mechanism of the latter effect. It takes place, as we know, when a wire or other conductor *moves* through a magnetic field. The result is the same, of course, if the magnetic field moves while the wire remains stationary. The essential factor is that the wire and the lines of magnetic force shall *cut across each other;* for if the wire moves lengthwise through the field or if it moves in the same direction as the lines of force, no current is generated.

The current generated when a conductor cuts across lines of magnetic force is called an *induced* current. The principles of *electromagnetic induction* were discovered in 1831 by Michael Faraday. That same year, Joseph Henry, who had been working independently on the problem, made many important additions to Faraday's results.

The direction of an induced current and the forces that cause it are best understood by examining Fig. 7, where we see the cross-section of a wire moving upward through the field of a magnet. It was Faraday's suggestion that we think of the lines of magnetic force that pass from the north pole to the south pole of a magnetic field as resembling invisible rubber bands that would stretch up around the wire as we see them doing for a considerable distance before they break and reform again below the wire. Now the crowding together of the lines at the top of the wire produces a partially circular field around it in which the direction of the lines is clockwise. Look back



Effect of a wire moving across a magnetic field.

at Fig. 2 and you see that clockwise lines of force are the *result* of a current moving away from you in the direction of your gaze. In the case of Fig. 7, the clockwise lines of force are the *cause* of a current moving in that same sense. As soon as the induced current begins to flow, it produces lines of force that coincide with those that induced it. A quick way of determining the direction of an induced current without the need of reflection, is the "three-finger rule." With the right hand held as in Fig. 8, point the thumb in the direction in which the wire is moving across the magnetic field, the index finger in the direction of the lines of force, and the middle finger will point in the direction of flow of the induced current.

Fig. 8

The Field Resists the Wire's Motion

The amount of current induced in a wire will depend upon the number of lines of force the wire cuts per second. Therefore the more numerous the lines of force (that is, the stronger the magnetic field) and the faster the wire moves through that field, the greater will be the current. Also, if instead of a single wire we move one side of a coil through the field, we increase the current in proportion to the number of turns of wire in the coil.

It might appear, then, that all we need to produce a boundless supply of electricity is some device for sending wires whizzing through magnetic fields. One thing interferes with this vision of "free power." The greater the current induced in a wire moving through a magnetic field, the more force is required to push it through. The lines of force in the field and the lines of force produced by the induced current are moving in the same direction and hence tend to thrust each other apart, just as two bar magnets laid side by side with their poles pointing in the same direction will thrust each other apart. This principle is known as *Lenz's law*. It explains why we have to hitch powerful engines to the generators that produce our electricity. And the more electrical power we wish to draw from them, the more mechanical power we have to apply.

The reader should turn to the article on Electric Generator and Motor to familiarize himself with further practical details in this field.

Peculiarities of Alternating Current

Much of the current in practical use in the world is of the type called *alternating* (abbreviated A.C.). This is simply a current that reverses its direction of flow at rapid intervals. Starting from zero it increases to maximum in one direction, and decreases until it returns to zero; then it increases to maximum in the other direction and returns once more to zero. The complete movement just described is called a *cycle*, consisting of two alternations.

Why alternating current is easier to produce than direct current (D.C.) is made plain in the article on Electric Generator and Motor. Here we will merely examine some of its peculiar properties.

A moment's thought will make it evident that when a current is increasing in a wire, the magnetic lines of force around the wire are increasing also—spreading out, so to speak, into the surrounding space; and that when the current is decreasing the lines of force are drawing in again. Around a wire carrying an alternating current, therefore, lines of force are continually expanding and contracting.

If we place another wire close beside this first wire, lines of force will be continually cutting through it, first in one direction and then in the other, although neither wire is moving. We know from our foregoing examination of electromagnetic induction that this will result in setting up an induced alternating current in the second wire. The same will hold true in greater degree if a coil of wire is placed beside another coil in which an alternating current is flowing. Upon this principle are based the induction coil and the electric transformer (*see* Transformer).

Self-Induction and Inductance

What is called *self-induction* takes place within a single coil when an alternating current flows through it. For the expanding and contracting lines of force around any one turn of wire in the coil are cutting through neighboring turns. The tendency of this self-induction is to set in motion a current which, in accordance with Lenz's law, will oppose the movement of the first current. When the first current is increasing in either direction, self-induction will tend to hold it back, and when it is decreasing, self-induction will tend to make it continue to flow. In brief, self-induction gives the current a kind of *inertia*.

Self-induction cannot, of course, actually produce a reverse current, but it does produce what is called a "back voltage" or "counter electromotive force" which decreases the forward flow of current. The amount of back voltage in a coil depends on the number of turns of wire, their arrangement, the quantity of current flowing, and the rate of change. The result of these factors is the *inductance* of the coil.

The Operation of Condensers

To understand the next peculiarity of alternating currents, let us first consider what is going on in Fig. 9. The positive charge on ball A causes a negative

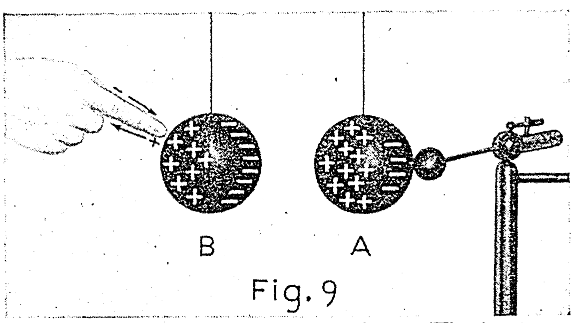


Fig. 9

The ball A receives its positive charge from a Wimshurst machine. Ball B has no active electrical connection.

charge to accumulate on ball B, as soon as you touch B with your finger or with any other conductor in contact with the ground. But as the negative charge on B begins to grow, it helps in turn to increase the

positive charge on A, since it tends to repel the electrons remaining there. This reacts once more on B, and so on until A accumulates a larger positive charge and B a larger negative charge than would be possible if each of them stood alone.

This method of increasing a charge in a body is called *electrostatic induction;* and the two balls constitute together what is known as a *condenser.* Their joint action is to concentrate or "condense" an excess of electrical energy into a given area. The measure of energy that a given condenser will accumulate is called its *capacity.* For practical purposes condensers are usually made of flat plates parallel to one another. This increases the interaction between them.

If a condenser is connected to a source of direct current, the current will flow into it until the capacity of the condenser is satisfied and will then cease. Not so if an alternating current is used. The latter will surge in and out of the condenser, first from one direction, then from the other; and the amount of current that will flow in the circuit will depend largely on the condenser's capacity.

Consider Fig. 10, disregarding for the moment the purpose of the coil (I). If the condenser (C) is large enough, the lamp (L) will burn, even though the continuity of the circuit is broken by the condenser.

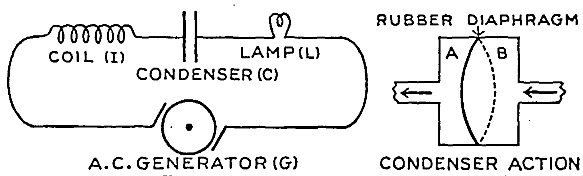


Fig. 10 Fig. 11

The position of the various units in this circuit could be reversed without materially changing the results described.

Although no actual current can flow across at that point, the attractive and repulsive force of the current (the electromotive force) does bridge the gap.

We may compare a condenser to a circular chamber (Fig. 11) divided across the middle by a diaphragm of sheet rubber, forming two compartments (A and B). The A.C. generator may then be compared to an air pump first drawing air out of one compartment and driving it into the other, then reversing its action. When the air is moving in the direction indicated by the arrows, the diaphragm is not only being *pushed* to the left by the pressure in compartment B, but is also being *drawn* in the same direction by the suction in compartment A, so that it bulges to the limit of its capacity. When the pressure-suction is reversed, the diaphragm bulges similarly in the opposite direction.

But here is an important point to notice. When the reversal of pressure takes place, the movement of air out of compartment B and into compartment A is speeded up at first by the fact that the diaphragm is stretched and wants *of itself* to return to the midpoint of the chamber. So up to that midpoint (and a little beyond, because of its momentum) it *helps* to drive the air out of B and to draw it into A. Condensers play much the same *elastic* part in circuits.

We are now prepared to understand the contrasting influence in an A.C. circuit of an inductance (coil) and a capacity (condenser). In Fig. 10, for example, when the current starts to surge back into the left side of the circuit, the inductance (I) with its effect of inertia tends to slow it down at first, but once it is flowing tends to prevent it from stopping. The capacity (C), on the other hand, with its elastic effect, tends to speed up the surging current at first; but after it has crossed beyond the zero point in the opposite direction tends to slow it down.

Uses of Inductance and Capacity

These two opposing tendencies are applied in many useful ways to A.C. circuits. Between them they determine the *frequency* (number of cycles per second) which will pass most readily through a circuit. This is made plain in the following comparison.

We know that if a piece of spring steel is clamped in a vise and then is bent and suddenly released it will oscillate back and forth at a fixed rate. This rate is called its *natural vibration period,* and is determined by the mass (inertia) of the spring, which as it increases tends to slow down the rate of vibration, and by the elasticity which, as it increases, tends to speed up the vibration. It is, of course, possible for an outside force to bend the spring back and forth at some other rate than its natural vibration period; but the nearer we approach to the latter, the more help we get from the spring.

Alternating current circuits likewise have a natural vibration period determined largely by the total inductance and capacity in the circuits. The nearer the frequency of the current that is to pass through a circuit comes to the circuit's natural period, the more easily it will be transmitted.

When the natural vibrating period of a circuit and the frequency of the current passing through it are exactly the same, they are said to be in *resonance* with each other. This is important in the "tuning" of radio transmitting and receiving sets (*see* Radio).

Another application is in ordinary long-distance telephone work. A condenser effect is inevitably present between the transmission wires and the ground, and this tends to establish a resonance that will magnify certain sound frequencies that pass over the wire and diminish others, resulting in what is called "distortion" of the message. By inserting into the line suitable inductances called "loading coils," the undesired resonances can be eliminated.

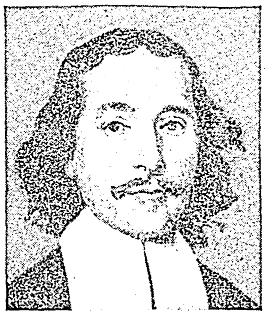
Here are some facts to remember about condensers: To avoid excessively large condenser plates, most condensers are made of two sections of several plates each, which are interleaved with some dielectric material (defined earlier in this article) between them. Mica is the dielectric commonly used for small condensers. The closer the plates are to one another the higher is the capacity, so the mica is made as thin as is possible without incurring the danger of a spark breaking through it. The higher the voltage across the condenser, the stronger must be the dielectric strength of the substance between the plates. The term *dielectric constant* applies to the ability of a substance to transmit the lines of electrical attraction and repulsion (not to be confused with magnetic lines of force) between the condenser plates. So the material used between the plates may increase or decrease the condenser's capacity. The dielectric constant of air is only about one-third that of mica.

The unit of capacity is the *farad,* and is defined as the capacity in which a charge of one coulomb will produce a potential difference of one volt. It is far too large a unit for practical use. The *microfarad* (one-millionth of a farad) is the usual unit. The unit of inductance is the *henry.* One henry will produce one volt of counter E. M. F. when the rate of change in current flow is one ampere per second.

It is evident that the inductance of a coil adds to its effective resistance. In other words, an alternating current has greater difficulty getting through a coil than a direct current. For this reason the application of Ohm's law to alternating circuits is often complicated.

The Men Who Discovered Electricity's Secrets

WHEN Thales of Miletus, one of the Seven Wise Men of Greece (about 600 B.C.) noted that amber, jet, and a few other substances, had the power when rubbed of drawing to themselves bits of leaves, straw, or feathers, he made the first discovery of electricity.



OTTO VON GUERICKE
Inventor of the First Electric Machine

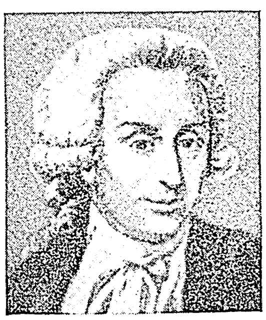
Pliny the Elder, a Roman who wrote a famous 'Natural History' in 70 A.D., tells of similar experiments, and also of painful "shocks" felt by persons who touched the torpedo-fish. It did not occur to him that both phenomena were due to the same cause.

There was little except scattered and useless information until the 17th century. Then Dr. William Gilbert (1540–1603), physician to Queen Elizabeth, wrote 'De Magnete' telling of many experiments with lodestones and the magnetic compass. He showed that the attractive force of amber, jet, wax, glass, and other substances when rubbed was not magnetic. This attractive force he called "electric," a word derived from the Greek name for amber (*elektron*).

The First Electric Machine Invented

Otto von Guericke (1602–1686) mayor of Magdeburg, Germany, earned a place in the history of electricity by inventing the first electric machine, a sulphur ball mounted on a shaft and rotated by a handle while rubbed by the operator's hand, thus producing electric sparks. He also discovered that electrified objects touched to non-electrified ones transfer some of their electricity.

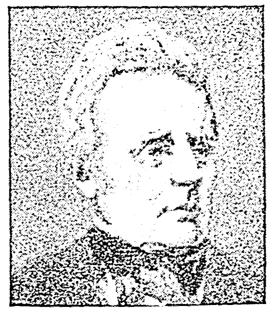
Stephen Gray (1696–1736) showed that some substances are conductors of electricity and others are not. He suspended a thread 800 feet long by loops of silk and sent over it a current of electricity produced by rubbing glass.



GALVANI
Who Learned About Electricity from a Dead Frog

In France, C. F. de C. du Fay (1699–1739) was first to distinguish between what we now call positive and negative charges. He believed these were due to two different kinds of electricity and originated the term "vitreous" for the positive and "resinous" for the negative. He found that objects charged with the same "kind" of electricity repel each other, but attract objects charged with the other kind.

Up to this time no one had succeeded in making and storing up electricity for use at will. But about 1745 a German clergyman, E. G. von Kleist, and a professor in the University of Leyden, Pieter van Musschenbroek, conceived the same idea independently. The first "Leyden jar" consisted simply of a glass vessel filled with water, which was charged by frictional methods. Later, Sir William Watson (1715–1787) and Dr. John Bevis (1695–1771) improved it to the form still used in classroom demonstrations, consisting of a glass jar coated inside and out with tinfoil, and capable of accumulating a heavy charge on the inner coating when the outer coating bears an opposite charge.

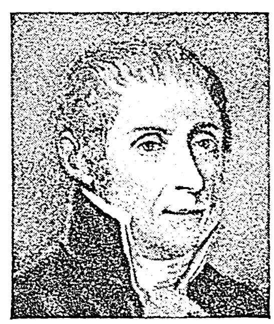


OERSTED
A Genius of the Magnetic Needle

Watson demonstrated that gunpowder could be exploded and alcohol ignited by a spark from a charged Leyden jar. His most important experiment was that in which he found that electricity seemed to travel almost instantaneously to the end of a two-mile wire.

Franklin's Great Experiments

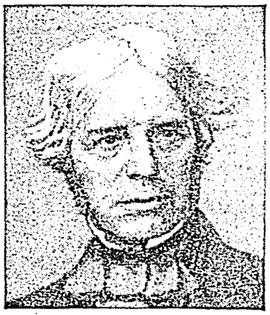
In 1752 Benjamin Franklin brought America into the history of electricity by his famous experiment with the kite. Franklin had observed an important fact—that electricity is most easily discharged from and collected by points—and desired to prove the identity of electricity and lightning by collecting the latter in a Leyden jar. Accordingly he flew a silk-covered kite, surmounted by a pointed wire to collect the electricity, during a thunderstorm. The wet kite string, conducting the electricity, was insulated from his body by means of a length of dry silk ribbon, and a door key was suspended at the end of the wet string. Soon electricity was conducted downward so that when Franklin brought his knuckle near the key a spark flew out. On that memorable day in June 1752, Franklin collected enough electricity to charge a Leyden jar, and his later experiments proved that it was in all respects the same as electricity produced by friction. This experiment suggested the lightning rod to Franklin. Later he was able to demonstrate that some clouds have positive and some negative electric charges (*see* Franklin, Benjamin; Lightning).



VOLTA
First Producer of Current Electricity

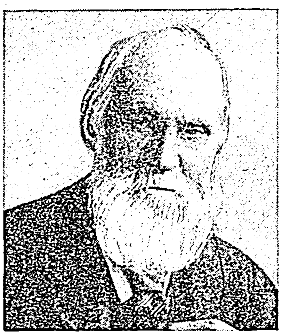
Following Franklin, many experimenters added to the sum total of knowledge bit by bit. John Canton (1718–1772), an Englishman, discovered electrostatic

induction, by which an electrified body produces an electric charge in another insulated body. Francis Aepinus (1724–1802), a German professor, extended Franklin's theory to account for magnetism. Others proved that the "shocks" given by such animals as the torpedo-fish are shocks of electricity manufactured in the animal's body.



FARADAY
Genius of Electromagnetic Research

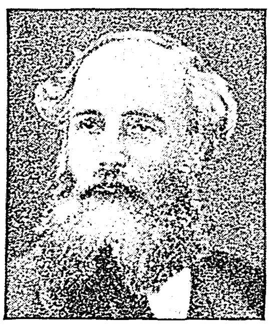
The eccentric Henry Cavendish (1731–1810), lived only for scientific research, and was even indifferent to the publication of his important findings, some of which remained unknown for many years after his death. He discovered the law that the force of electric attraction between bodies varies inversely as the square of the distance separating them. This was called Coulomb's law, named for the French engineer Coulomb (1736–1806), who worked out the law independently a little later. Cavendish also anticipated by nearly 50 years the discovery by Georg Simon Ohm (1787–1854) of the fundamental law of electric flow, known as Ohm's law.



WILLIAM THOMSON
Explorer in the Great Field of Electrochemistry

Galvani and Volta

In 1790 Luigi Galvani (1737–1798), professor of anatomy in the University of Bologna, hung a dead frog over an iron railing by a copper hook through the frog's back. The creature's body was immediately convulsed by lively twitchings. Galvani concluded that the body was a kind of naturally charged Leyden jar discharging electricity through the railing and the hook. Alessandro Volta (1745–1827), professor of physics in the University of Pavia, took issue, claiming that the source of the electricity was not the frog's body but the contact between the copper and the iron. He proved this by constructing the first voltaic pile, in which a zinc plate and a copper plate in contact have a slight difference in electric charge. He showed that if several pairs of such plates are separated by cloths moistened with acid or salt solution, and if the first pair is joined to the last pair by a wire, a steady electric current is produced. It was only a step from this voltaic pile to the voltaic cell, in which an electric current is produced by a pair of dissimilar metal plates connected by a wire and dipped in an acid or salt solution; and only another step to the "crown of cups," as Volta in 1800 called his first voltaic battery.



MAXWELL
Father of the New Wave Theory

The voltaic pile, cell, and battery are sometimes called "galvanic" in honor of the man whose experiment started the inquiry, and the current generated was long known as "galvanism." Galvani is also remembered in the galvanometer, which measures electric current, and in galvanizing, which at first was an electrolytic or galvanic method of applying zinc to iron, but now more commonly done by dipping in molten zinc.

HERTZ
Forerunner of Marconi in Wireless Telegraphy

These discoveries foreshadowed the great link that was to be established later between chemistry and electricity. William Nicholson (1753–1815) in 1800 decomposed water by the voltaic current into oxygen and hydrogen. Sir Humphry Davy (1778–1829) later discovered the elements potassium and sodium by electrolizing fused potash and soda. In 1809 Davy demonstrated the principles of the arc light.

Magnetism Linked with Electricity

In 1820 Hans Christian Oersted, professor of natural philosophy in the University of Copenhagen, confirmed the suspected relationship between electricity and magnetism by announcing his discovery of the deflection of a magnetic needle by an electric current. The significance of this discovery was recognized by others, and the French academicians André Marie Ampère (1775–1836) and D. F. Arago (1786–1853) announced the fundamental laws of the electrical science known as "electrodynamics," which was to give the world in later years the electric motor, the telephone, and many other marvelous inventions.

SIR J. J. THOMSON
Father of the "Electron Theory"

A few years later an Englishman, William Sturgeon, constructed an electromagnet; it was improved by the American physicist Joseph Henry (1797–1878), thus inventing in principle the electric telegraph, although another American, S. F. B. Morse (1791–1872), perfected it.

Michael Faraday (1791–1867), an English chemist, like his master Sir Humphry Davy, attacked electrical problems with tremendous imagination and for 34

years made many important discoveries in electromagnetism. In 1831 he discovered the principle of the induction coil (*see* Transformer) and of the electric dynamo (*see* Electric Generator and Motor). He demonstrated that electricity, no matter what the source, is identical in nature.

William Thomson, who later became Lord Kelvin, (1824–1907) brought precision and order into electrical science, and linked firmly its principles to those of chemistry and physics. To him may be ascribed much of the development which made possible the submarine cable (*see* Cables, Submarine).

Clerk-Maxwell and the Ether Theory

James Clerk-Maxwell (1831–1879) rejected the idea that electricity exerted a "pull" across empty space. Electric stresses and strains, according to his theory, produce wave motions in the ether of space; and he was thus led to investigations which pointed the way for wireless telegraphy and telephony. Clerk-Maxwell showed that electric phenomena display mathematical relations corresponding to the phenomena of light, and he inferred that light, heat, and electric waves are of much the same nature at bottom.

Heinrich Rudolf Hertz (1857–1894), professor of physics in Karlsruhe, Germany, became interested in Clerk-Maxwell's theories, and succeeded in producing electromagnetic waves, and was able to show that, like light, they are transverse, and can be reflected, refracted, and polarized—another step in the progress of scientific theory, as well as the preliminary to the practical development of radio methods begun by Guglielmo Marconi (1874–1937), and continued by a great host of investigators and inventors.

Growth of the Electron Theory

Many of these men have contributed to the electron theory: Faraday's theories contained a hint of it; Clerk-Maxwell used the phrase "a molecule of electricity"; George Johnstone Stoney called the as yet undiscovered ultimate unit of electricitv an "electron." It was Sir J. J. Thomson (1856–1940), professor of experimental physics at Cambridge, who measured the mass and determined the electric charge of the particles in cathode rays (*see* Electronics; X-Rays), and identified them with the ultimate particles of electricity now known as electrons.

The contributions of some men have earned for them the popular title of "wizards," men such as Alexander Graham Bell, who invented the telephone; Thomas Alva Edison who invented the electric light; Nikola Tesla who devised the alternating-current induction electric motor; and William Roentgen, the discoverer of X-rays.

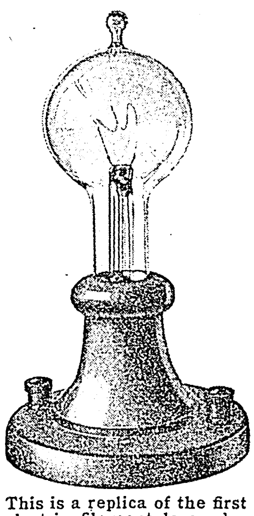
There are many others, less widely known, who have been responsible for the invention and development of the electric street-car, the wireless telephone, turbo-dynamos, electrochemical methods—a few of the inventions of the mighty host of diligent workers who have given the world gifts of untold value.

HARNESSING ELECTRONS *to Get* POWER, LIGHT, *and* HEAT

ELECTRIC LIGHT AND POWER. A silent servant speeds through the vast network of our electric light wires, lights our cities, drives thousands of street-cars and trains, and turns millions of wheels in great industrial plants. More than 40 million tons of coal have been burned in one year to produce this energy. The same current that boils our coffee and toasts our bread keeps our refrigerators freezing cold. Harnessed to suitable apparatus, it reproduces the health-giving ultra-violet rays of the sun. With it our moving pictures are first made, and then projected on the screen. Its chemical energy is used in producing the plates from which this book is printed and in extracting metals from ore. We put it to work cleaning our houses, carrying our messages, running and regulating our clocks, driving our fans, pressing our clothes—the list of jobs we give it is almost endless.

Light, mechanical power, heat, chemical effects—it would be difficult to say which of our uses of electric current is the most important. Most of us would probably vote for light. The latest census indicated that about three-quarters of American homes are electrically lighted, and the proportion is growing larger every day, as current is being distributed further and further into remote districts.

EDISON'S GIFT



This is a replica of the first electric filament lamp devised by Thomas A. Edison for commercial use. The replica was built under Edison's supervision in 1929.

The first electric light was an arc lamp. Sir Humphry Davy discovered it as early as 1801. However, it was not until 1878 that C. F. Brush of Cleveland devised an arc-lamp system efficient enough for commercial use. Within a few years Brush lamps were in standard service for lighting streets and factories.

The Carbon Arc Light

In the arc lamp there are two carbon rods or "electrodes" with their ends close together. A powerful electric current crosses the gap and heats the points of the electrodes white hot. These fiercely glowing arcs are still the most brilliant of artificial lights. They continue to be used extensively for searchlights, for a certain type of motion-picture projection, and for purposes requiring concentrated illumination of great intensity. However, the arc light has never been suitable for ordinary domestic use. It cannot be efficiently developed into small lamps, since the burning up of the electrodes calls for constant readjustment and replacement.

The Cooper-Hewitt mercury arc lamp, based upon the principle that an electric current passing through mercury vapor inclosed in a vacuum tube produces a brilliant glow with no red rays, was brought out in 1901. This lamp was admirably suited to photography and to the lighting of printing plants, and other places where glare would be trying on the workers' eyes. It has never been found practical for general illumination as it produces unnatural color effects, and has a delicate and costly structure. Aside from its light-giving qualities, the mercury-vapor arc is the most powerful source of ultra-violet rays, provided it is inclosed in a fused quartz tube instead of the ordinary glass, through which the rays cannot pass.

Between 1878 and 1880 Thomas A. Edison and Joseph W. Swan perfected practical incandescent lamps. Edison's main problem was the finding of a suitable *filament*, or substance fine enough to heat up and glow with a current of moderate power. It had to stand a high temperature without melting; and it had to be rugged enough to endure mechanical shocks. After long experiment he produced a suitable filament by carbonizing cotton thread, for which he later substituted carbonized bamboo fiber.

Imprisoned in a Vacuum

This filament had to be inclosed in a vacuum, for it would have burned up in the presence of air. So Edison designed an all-glass bulb with a small projecting tube. After the air had been pumped out through it, this tube was melted shut. The two wires fastened to the carbon filament passed through air-tight seals in the base of the bulb. These had to be made of a metal which, when heated, expanded the same amount as the glass. Otherwise, when the whole bulb became hot the seals would break. Platinum was at the time found to be the only metal suitable for this purpose.

The carbon filament had one disadvantage. It fell apart rapidly when heated by a current to the white glow required for maximum lighting efficiency. For this reason, the old carbon lamps could give only a yellowish illumination. Various metals of greater chemical stability and high melting points, such as osmium and tantalum, were tried out in its place.

Development of the Modern Lamp

At length in 1910 the modern filament of drawn tungsten wire was evolved (*see* Tungsten). In a vacuum bulb, even the tungsten filament tends to evaporate at high temperatures, throwing off particles and thinning itself down until it "burns out," meanwhile blackening the inside of the glass. To minimize this trouble, gas-filled lamps were devised in 1913. Inert gases, such as argon or nitrogen, or a mixture of the two, which will not attack the tungsten chemically even when the latter is white hot, are sucked into the bulb after the air has been pumped out. The pressure of this gas partially prevents the tungsten particles from leaving the filament, thus allowing it to be raised to a hotter, brighter glow.

In virtually all the present vacuum-type (Mazda B) lamps as well as in the gas-filled (Mazda C) lamps, the filament is wound into a very fine spiral, and mounted in this compact form to better maintain its heat. The fine metal brackets that support the filament in the vacuum lamps are made of tungsten, in the gas-filled lamps of molybdenum, which has almost as high a melting point as tungsten and better mechanical properties. The sections of the lead-in wires, which carry the current to the filament supports, are no longer made of expensive platinum, but of a copper-plated nickel alloy that matches exactly the heat expansion of glass. The base of the lamp is made of brass to which the lead-in wires are soldered or welded.

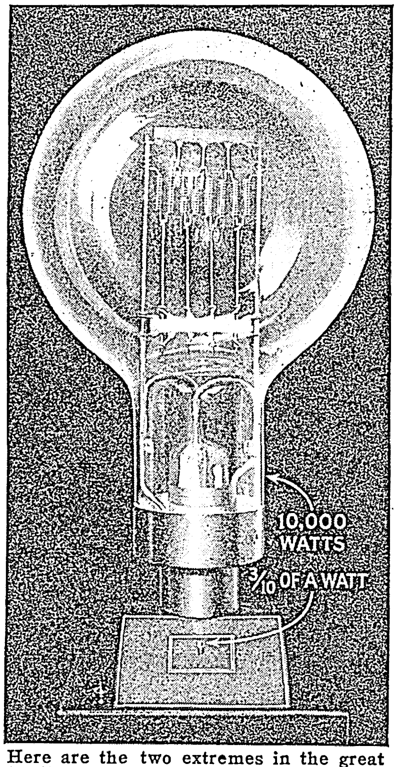
One of the latest major lighting improvements was the introduction in 1925 of the inside-frosted lamp. It diffuses the light with little loss from internal reflections and permits a standardized method of manufacture which has greatly lowered the cost of lamps.

An Amazing Mechanical Feat

The manufacture of the standard household lamps is one of the triumphs of automatic machinery. There is, for example, a single mechanism into which bulbs, tubes, rods, filament wire, support wire, bases, and packing material are fed. Out of it come finished lamps, exhausted or air-sealed, marked, tested, wrapped, and packed in a case ready for shipment.

A tremendous variety of other lamps is produced. They range from the huge beacon lights used at airports, to the tiny bulbs on the end of the physician's gastroscope or sinuscope, with which he can look down a patient's throat into his stomach or explore the sinuses of the head. A powerful beacon of more than 2,000,000,000 candle power lights the sky of Chicago guiding aviators in their flights over the city. At airports there are whole batteries of powerful lights —rotating beacons of several million candle power

THE GIANT AND THE MIDGET



Here are the two extremes in the great family of standard electric lamps in common use today. Above is the powerful lamp employed in floodlighting airports and moving-picture studios; below, too tiny to show well on the same scale, is the sinuscope lamp, which is so small that physicians can get it into the cavities connected with the nose.

that can be seen in all directions; boundary lights to show the shape and size of the field; green lights to indicate the best approaches; red lights to mark obstructions; and floodlights to make the field as clearly visible as in the daytime, without any glare that might blind the flyer. Floodlights are used also to brighten buildings at night, and to light fields for sporting events.

Lamps by the Billion

The world consumes about 1½ billion lamps annually. More than half of this total is distributed in the United States. Since many lamps last more than one year, the country probably has about a billion lamps in use at any one time. The most usual size is 60 watts. About half of all the standard lighting lamps are used in homes. Perhaps 10 per cent are used in signs, and the rest in street, factory, and office lighting. Next in use are automobile lamps, about 150 million a year; then come about 80 million Christmas tree lamps, and 60 million flashlight lamps. Making all these lamps requires about 110 tons of tungsten, or a cube six feet on each side, and 30,000 tons of glass a year.

Advances in Lighting

For many types of lighting, engineers have produced *vapor* lamps, operating with ionized vapor as explained in the article on Electrochemistry. Such lamps using sodium provide inexpensive light for highways (*see* Sodium). Others using neon are important in outdoor night advertising (*see* Electric Signs). One type has the inside of the tube coated with material which *fluoresces* when struck by ultraviolet radiation from the glowing vapor in the tube (*see* Light). These fluorescent lamps give one-fourth less heat and from two to twenty times as much light as filament lamps using equal power. By combining various elements of the lamps, an almost exact match for daylight is obtained. Since the light comes from a long tube, it is soft and free from glare.

Illumination has been improved vastly by *indirect* lighting. Bulbs and reflectors are arranged to throw light against walls and ceilings, and so diffuse the light evenly. Similar methods, combined with floodlighting, are used increasingly out-of-doors.

Electric Power Production

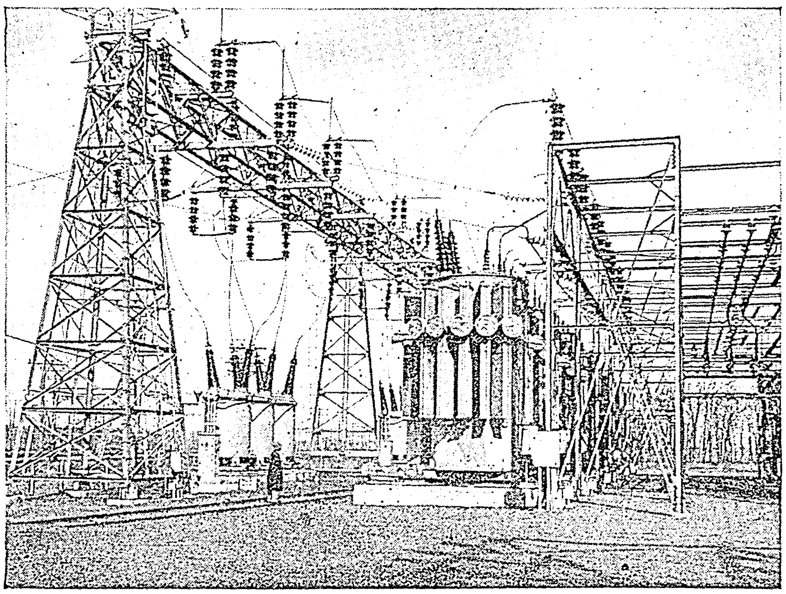
The United States is equipped to produce at least two hundred billion horsepower of electrical energy in central stations supplying electricity for light and power. Construction of huge dams such as those of the Tennessee Valley Authority and Bonneville increased power capacity enormously. (*See* Dams.)

The first central generating system in the United States was set up by Edison in New York in 1882. Today the country's plants number more than 4,000. These are of two kinds—fuel-burning and hydroelectric (water power). The latter produce more than one-third of the nation's current (*see* Water Power).

In the majority of these stations the generators (dynamos) turn out alternating current at 2,000 to 11,000 volts. If it has to be sent over any great distance *step-up transformers* (*see* Transformer) raise it to voltages ranging sometimes up to 220,000 or more volts. The reason for such high voltage is that there is much less loss, and much finer wires can be used, when transmitting at high voltage than at low (*see* Electricity). For safety's sake these high-voltage currents are carried across country through cables supported high above the ground on steel-framed towers.

At substations, near cities or factories where the current is to be used, it is stepped down again, usually for street lines, to about 2,300 volts. Before actually entering buildings it passes through another small transformer attached to the pole or underground conduit; this reduces the current to 110 or, in some localities, 220 volts. In places where direct instead of alternating current is required, devices called "rectifiers" are employed in the substations.

A HUGE "PUMPING STATION" FOR ELECTRIC POWER

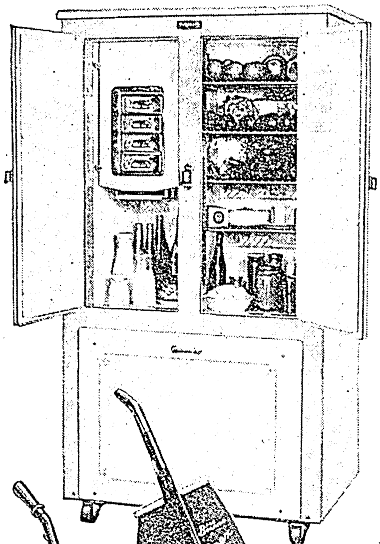


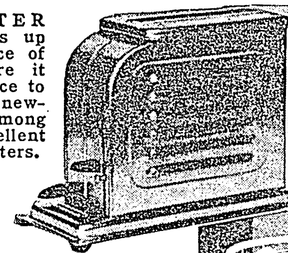
Those giant transformers in the center act like pumps in a water supply. They "step up" the current to a "pressure" of 132,000 volts so that it can be sent on long journeys over thin wires. The wires are carried across country on those steel towers. Note the big insulators that hold the wires away from the steel framework. Three smaller transformers stand at the left. This station is situated near Chicago, Ill.

Handling "Peak Loads"

One of the great problems in electric plants is to handle what is called the "peak load" or maximum demand for current in the localities they serve. An example will illustrate the point. Wilmington, Del., is an industrial center using its maximum power in daylight hours; Atlantic City with its "bright

ELECTRICITY AS A MAID OF ALL WORK

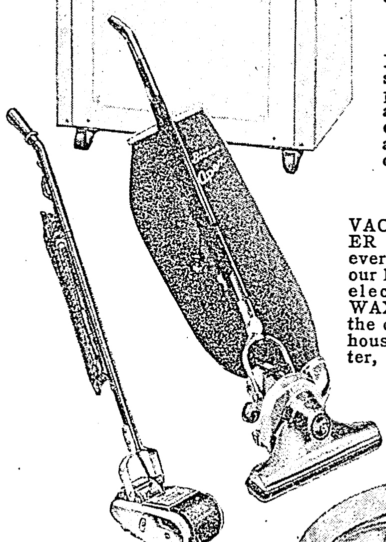




A TOASTER that shoves up a nice piece of toast before it has a chance to burn is the newest model among many excellent bread-toasters.

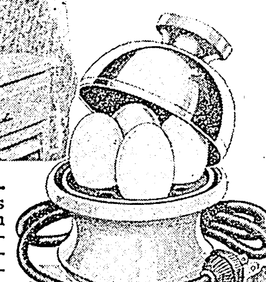
THE ICE-BOX, which has long been an important health agent in the American home, now operates by electricity in some of the most up-to-date types. It freezes cubes of ice, and nobody has to put the card out for the iceman.

DISH-WASHERS, which make short work of the most unpleasant task in housekeeping, are becoming more and more common. Some styles are built as part of the kitchen sink, others are separate, as is the model shown at the right.

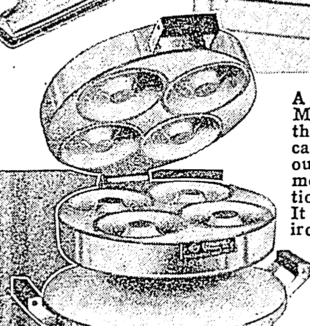


VACUUM-CLEANER music is heard every day in most of our homes. Now an electric FLOOR-WAXER has joined the cleaner to make housekeeping better, quicker, easier, pleasanter.

A MIXER which is a genuine maid of all work is now appearing in many kitchens. It mixes dough, mashes potatoes, whips cream and mayonnaise, chops meat, extracts orange juice, chips ice, freezes ice-cream, beats eggs, grinds coffee, sieves or shreds vegetables, and does many other useful jobs.



EGG-BOILERS which bring the egg to just the right degree of hardness are a recent invention. The amount of water put beneath the eggs regulates the current, turning it off when they are soft or hard, as you wish.



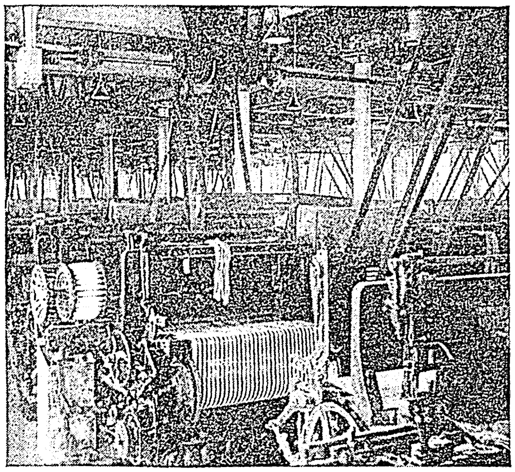
A DOUGHNUT-MAKER which makes this famous American cake, hole and all, without frying it in fat, removes the last objection against doughnuts. It works like a waffle-iron and will also cook muffin dough in "sinker" shape.

WASHING-MACHINES of many kinds have made a light task of the hardest work in the home. Some of them work by suction cups, others by oscillating the clothes. Some have an electric wringer, others whirl the clothes dry, ready for the electric iron or electric mangle to smooth them. The electric washer is one of the greatest contributions toward solving the constant American servant problem by machinery.

ELECTRIC SEWING-MACHINES do away with the treadmill labor of running a foot-power machine, and furnish a far more even motion and hence a more even stitch. The one in the picture is started and stopped by a knee switch. A small electric light on the machine, shaded from above, lights the work and prevents eye strain.

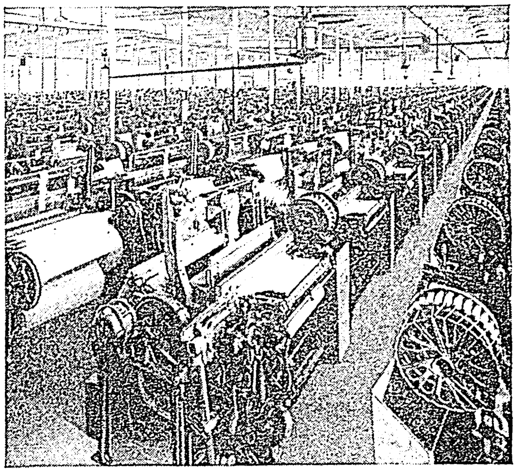
lights" has its peak load at night. In the days before long-distance transmission was achieved, each city had its own isolated plant; each had to have equipment enough to handle the peak hours, most of which equipment lay wastefully idle the rest of the time.

A COTTON MILL BEFORE AND AFTER ELECTRIC "TREATMENT"



At the left is an old-style weaving-room. The power for the machines comes from a central plant through a maze of shafts, pulleys, and belts. Dirt, danger, and waste of power through friction were the results.

At the right is a weaving-room in which each machine has its own electric motor. Greater safety, cleanliness, and economy are the direct results.



Today plants are connected together in groups and "super-power" chains, so that the same stations can serve Wilmington by day and Atlantic City after dark.

In and around New York City is a chain of plants representing the greatest concentration of power in the world. If one unit breaks down, the others immediately take up the load. Even so, the greatest precautions have to be taken against emergencies. Automatic detectors announce the approach of storms that may darken the city and cause millions of lights to be turned on suddenly. When the warning comes, additional generators are started and held in readiness to be switched in to the distributing lines. A dramatic illustration of the peak-load problem took place in the first World War. A New Jersey munitions plant blew up in the early hours of the morning. The roar of the explosion shook New York City. Thousands of people jumped out of bed and turned on their lights. Unprepared for this sudden drain of power, the system, not interlocked then as now, broke down.

How Industry Uses Electricity

Nearly three-quarters of the horse-power used in the United States factories is electrical. The rapid electrification during the last few decades has caused a new industrial revolution. Automatic machinery, the chief factor in standardized mass production, would hardly be possible without the smooth, steady, easily controlled action of electric motors. Formerly power was distributed throughout the factory from a central steam engine with line shafts, counter shafts, pulleys, and belts, producing a maze of wasteful and dangerous moving parts. Today we see the machines —drills, presses, conveyors, etc.—each with its own compact motor. The steam plant has to run at the same rate whether one or one hundred of the factory's machines are in use; the individual electric motors can be turned on and off as needed.

A single tank heated by electricity melts in one operation 45 tons of zinc used for galvanizing. Electric furnaces provide a wider and more delicately graded range of temperatures than is possible with either coal or gas (*see* Furnace). Electric welding has brought far-reaching changes in the manufacture of metal products, and in construction work (*see* Welding). The ability of electricity to split up chemicals in solution is applied in hundreds of ways, such as extracting metals from their ores, purifying them, plating them on other metals, and so on. The whole aluminum industry depends on this type of process. More and more is electrical power, long used in street-cars, being extended to the operation of railroads (*see* Railroads). The swift elevators that make modern skyscrapers practical could scarcely exist without electric power.

While most of the electric power used in homes is for lighting, a tremendous amount goes to operate the ever-growing number of household appliances, such as irons, vacuum cleaners, refrigerators, and radios, which have reduced household monotony and drudgery.

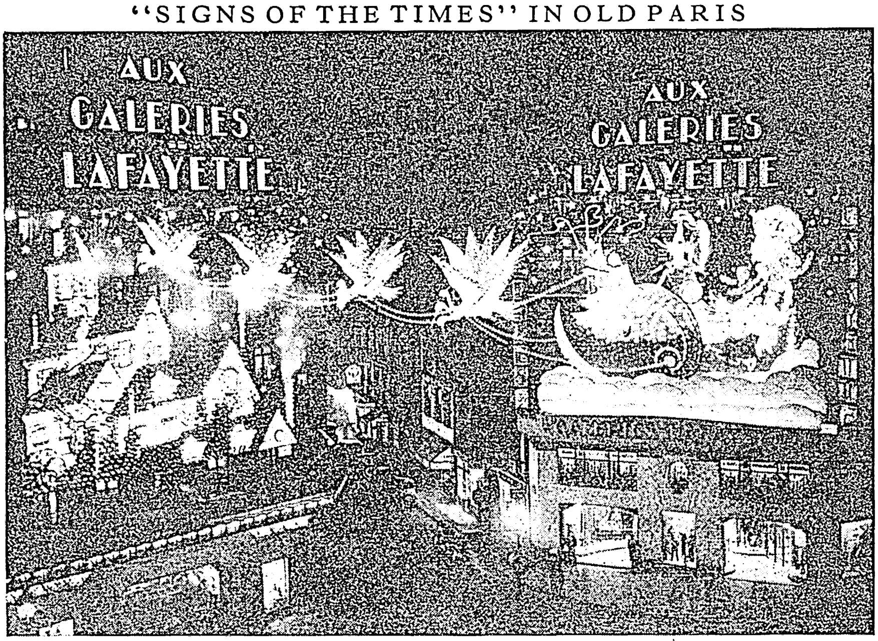
Electric power generated by independent units, rather than at central stations, finds its commonest application in the automobile. (*See* Automobile.) Many ships are driven with electric motors, the current coming from generators run by steam turbines or Diesel engines. The Diesel-electric principle is also applied to locomotives on railroads.

Rural Electrification

Some farms too develop their own electricity with gasoline, Diesel, or wind-driven generators. But gas-engine plants are expensive to operate, and wind-driven plants are limited in output of power. Hence widespread rural electrification must depend on cheap current from central generating plants. The Federal government is attempting to make this available through the Rural Electrification Administration, created in 1935 to extend long-term loans for power-line

construction and wiring of farm buildings. At the end of 1934 only 11 per cent of the country's farms were electrified. Within a few years this proportion had been doubled. But the United States still lags far behind many countries, notably Switzerland, Holland, Belgium, Germany, France, and Italy, which are from 90 to nearly 100 per cent electrified. (*See also* Agriculture, page A-51.)

"SIGNS OF THE TIMES" IN OLD PARIS



The use of electric signs for advertising originated in the United States, but it has penetrated the large cities of Europe. Here is an animated display over a Paris department store, representing Santa Claus, drawn by a flock of storks bringing gifts to an Alsatian village. Many thousands of electric lamps are needed to produce such an effect as this.

ELECTRIC SIGNS. New York City's "Great White Way" owes its brilliance to nearly 4,000 large electric signs distributed from 34th to 59th Street and from Sixth to Eighth Avenue, the accepted limits of this world-famous district which is diagonally bisected by Broadway. Here, in less than a third of a square mile, more than half a million lamps in these signs flash on nightly, making it the most vividly illuminated spot in the world.

Yet, though New York may be said to have set the fashion in the use of electric signs, virtually every other modern city and town from Shanghai to Berlin and from Buenos Aires to Quebec has its own "white way" where glowing letters, shifting slogans, and animated figures proclaim in many colors the merits of an automobile tire, a tooth paste, or a restaurant.

Huge Sums Spent for Signs

Originally, theaters and other places of amusement were the greatest users of electric signs, and an actor who got his name "in the lights" had the most conspicuous evidence of success; but today mercantile advertising outshines the theater announcements. Millions of dollars are spent in this kind of bid for public patronage. One company spent over a million and a half a year for several years for its New York signs alone. The owners of what was at the time the largest sign in the world, standing on a four-story building near Times Square, New York, paid nearly a hundred thousand dollars a year for the use of the roof that supported it. The sign was 200 feet long and more than 50 feet high, and contained 19,000 lamps.

The first large electric sign was built in 1895 at the corner of Fifth Avenue and 23d Street, flashing the news "Manhattan Beach Swept by Ocean Breezes." This and other early signs either burned continuously during the first hours of the night or flashed on and off at regular intervals to gain greater attention. Today many of the signs are arranged so that letters and words can be changed at will, animated pictures can be made to appear, colors and brightness can be altered. Newspapers and moving-picture houses use signs in which a continuous stream of words seems to flow around a building, telling of the happenings of the day or of the attractions awaiting theater patrons.

All these effects are accomplished by having the lamps, which stud the face of the sign, wired together in many separate patterns and circuits, each of which can be turned on and off at the proper instant by the movement of automatic switches. For example, a space four feet square may contain more than 500 small 10-watt lamps, ingeniously connected together into 26 different circuits to form any letter of the alphabet that may be required in that one space alone.

How Neon Signs Are Made

In addition to the signs produced by combinations of single electric bulbs there are those of the "neon" type consisting of slender glass vacuum tubes containing small quantities of various gases, set glowing by the passage of a high-voltage current. The tubes are bent into the shapes of the desired letters or ornaments, and the first ones made contained neon gas. This produces a penetrating red light that is visible in broad daylight or through heavy mist. Other gases give other colors. Mercury vapor gives blue; helium in an amber tube gives a golden glow; green is obtained with a blue glow in a yellow tube. When several gases are used in combination, the resulting colors combine to give white (*see* Color). Similar effects are obtained by adding fluorescent material to the tubes, and exciting it with radiation from mercury vapor (*see* Electric Light and Power).

ELECTROCHEMISTRY. All of chemistry is closely related to electricity, but the name electrochemistry is by custom reserved for the science dealing with chemical reactions that produce, or are produced by, electric currents. In this field the phenomenon called *ionization* rules supreme.

Ions are atoms or molecules that have lost or gained electrons and in that condition take part more or less independently in chemical or electrical activity. Those that have lost electrons are positively charged (*cations*); those that have gained electrons are negatively charged (*anions*).

Ionization occurs to a limited extent in all liquids, but is sufficient for practical purposes only in solutions of *acids*, *bases*, and *salts*. It is largely because these three types of compounds always *dissociate* into ions when they go into solution that they are so active chemically. They are often called *ionogens*, that is, "ion generators." The mechanism of dissociation is explained in the articles on Acids and Alkalies; Chemistry; and Electricity.

An acid may be defined as any substance which in solution has *hydrogen* for its positive ions. A base is any substance which yields *hydroxyl* (OH) for its negative ions. A salt is any substance which yields positive ions *other than hydrogen* and negative ions *other than hydroxyl*.

The Effect of a Current on a Solution

When an electric current passes through a solution it is transmitted by the ions, and the result is always a *decomposition* of the dissolved substance. For example, in a solution of hydrochloric acid (HCl), the positive hydrogen ions travel to the negative electrode, where they acquire electrons to replace those lost in dissociation. This turns them into plain hydrogen atoms which bubble away. The negative chlorine ions, on the other hand, seek the positive electrode where they give up their surplus electrons, become plain chlorine atoms, and also bubble away.

This permanent break-up by an electric current of an already dissociated compound is called *electrolysis*. If the products of the decomposition are solids, they may deposit themselves on the electrodes or fall to the bottom as precipitates. With electrodes made of metals or other substances that will themselves dissolve in the solution, many useful chemical substitutions and transfers can be achieved, as in electroplating and similar processes.

The Production of a Current by a Solution

The converse of electrolysis—namely the generation of current by a chemical solution in an "electric cell"—requires, as explained on page 225 of this volume, a twofold chemical action in which the conductors or terminals that dip into the solution must play a part. The action is like an ordinary chemical *displacement* (a second group of positive ions throws out of solution the group that was in the solution first), except that it takes place at long range through the medium of the wire and whatever apparatus is being operated by the current from the cell. The first half of the displacement takes place at the *negative* terminal. Atoms of the metal composing this terminal abandon some of their electrons and go into solution as positive ions. The abandoned electrons pass around the outside circuit to the *positive* terminal. There they attract, meet, and attach themselves to members of the first group of positive ions, turning them into neutral atoms which throws them out of solution and completes the second half of the chemical displacement.

How Metals Differ in Activity

The fact that one group of positive ions can replace another in this fashion is one of the most important facts of chemistry.

In the accompanying list the common metals and hydrogen (which behaves in this case like a metal) are arranged in the order of their readiness to part with electrons. Lithium loses electrons more easily than potassium, for instance; potassium more easily than sodium, and so on.

The list is variously called the "activity series," the "displacement series," and the "electromotive series."

Lithium
Potassium
Sodium
Barium
Calcium
Magnesium
Aluminum
Manganese
Zinc
Chromium
Cadmium
Iron
Cobalt
Nickel
Tin
Lead
Hydrogen
Copper
Arsenic
Bismuth
Antimony
Mercury
Silver
Palladium
Platinum
Gold

Because of its greater tendency to let go of electrons, each metal bears the following relations to any metal below it in the list: it is more active chemically; it oxidizes more easily and hence is less likely to be found free in nature (the metals above hydrogen are virtually never found free—those below hydrogen are frequently so found); and *it will displace the lower metal from ionic solution.*

Thus zinc will displace copper from a solution of copper sulphate, precipitating metallic copper, and so will iron; but silver will not displace the copper. If iron has displaced the copper in the solution and then zinc is added, the latter will in turn displace the iron. If pairs of metals are used for the terminals of a cell, the metal higher in the list will always be the negative terminal; and the farther apart the metals are in the list, the greater will be the voltage of the cell. On the other hand, in the electrolysis of solutions of metallic salts, the higher the metal stands in the list the higher will be the voltage (electromotive force) required to push it out of solution and deposit it on the cathode.

Ionization of Gases

Gas atoms may become ionized as the result of collisions among themselves or because heat, light, ultra-violet rays, X-rays, or other forms of radiation temporarily drive electrons out of the atoms.

Whatever the cause of ionization in a gas, it makes the gas a conductor of electricity in precisely the same manner as do ions in a liquid. A charged electroscope will be discharged when the air around it is ionized. This provides an important method for detecting and measuring the intensity of various types of radiation. Cosmic rays were discovered by observing the slow discharge of an electroscope which was shielded from all other known forms of radiation.

Ionization does not play such an important part in the chemistry of gases as it does in that of liquids. The chief practical application of the electrical conductivity of gases is found in mercury-vapor and "neon" lights, and various types of rectifying tubes and glow-lamps (*see* Electronics).

ELECTROLYSIS. Whenever an electric current is transmitted through a liquid, some or all of the compounds that compose the liquid are decomposed into simpler substances. This process is called *electrolysis,* from Greek words meaning "electric loosening." It can take place only in liquids which contain other substances in solution, so that positive and negative ions are formed (*see* Chemistry; Electricity; Electrochemistry).

Certain metals are produced by this process, as in the electrolysis of fused, dry caustic soda into the metallic sodium. Many metals such as gold, silver, aluminum, copper, zinc, and nickel, are reduced and refined by electrolytic processes. Electroplating and electrotyping are adaptations of the process.

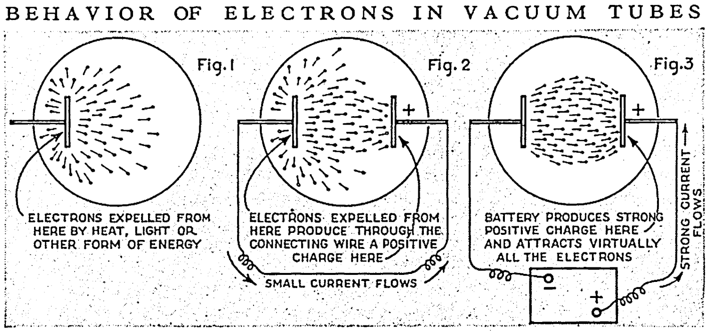
The term electrolysis is often employed to describe the erosion of gas and water mains in the ground due to stray currents from street-car lines.

ELECTRON. The smallest particle of matter, about $\frac{1}{1850}$ the mass of the hydrogen atom. The atom was thought to be the limit of smallness until electrons were identified in 1897. (*See* Atoms and Electrons.)

The NEW SCIENCE *of Electronics and Its* MANY USES

ELECTRONICS. If you examine a textbook on electricity published before 1930, you will probably search its pages in vain for the term "electronics." If the book was written during the 20 years preceding 1930, there will be, of course, many references to electrons, for during that period electrons became more and more closely identified with all types of electrical phenomena, and indeed, with the very structure of matter itself. But most of what you read will deal with the behavior of electrons when they accumulate as static charges in various substances, when they flow as currents in electric circuits, or when they move through chemical solutions.

BEHAVIOR OF ELECTRONS IN VACUUM TUBES

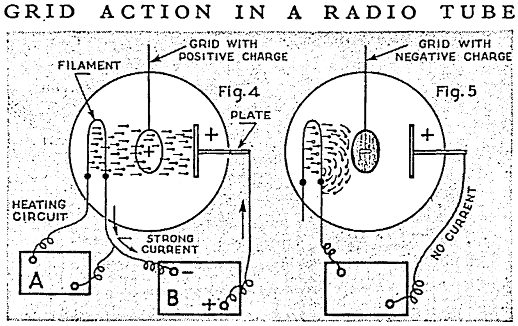


The text explains these three steps in the evolution and control of a stream of electrons inside a vacuum tube. This stream is as much a part of the circuit as the wires outside the tube. Its value lies in the fact that it responds to extremely delicate influences and that its response is swifter than any other known device for increasing or decreasing current flow in a circuit.

These actions of more or less closely confined electrons still form the main body of electrical science. The article Electricity and other related articles in these volumes discuss them in detail. Here we shall consider *the behavior of electrons when they are moving through space by themselves.*

That electrons *do* leave their atomic homes and venture out, so to speak, into the open has been known since 1897 (*see* Atoms and Electrons). But for many years the production of X-rays was the only practical service to which the wanderers were applied. They aroused enormous scientific interest and gave rise to a whole new set of physical and chemical teachings; but the layman, unless he underwent an X-ray examination, never saw any evidence of their independent activity (*see* X-rays).

GRID ACTION IN A RADIO TUBE



The sole purpose of battery A is to heat the filament of the tube so electrons will be driven from it to form the conducting stream. The text tells how the variation of charges on the grid may alternately encourage or turn back the electron stream.

Then came the development of radio, and before long, thousands of schoolboys knew that the efficiency of their home-made receiving sets depended on streams of invisible electrons passing "from filament to plate" inside their radio tubes (*see* Radio).

Shortly after the rise of radio, it became apparent that the "electric valve" effect, which made the radio tube perform such wonders, could be applied to a wide variety of other uses. Later came the photoelectric cell and its many applications. In short, within the space of a few years so much of technical and popular interest had been discovered and invented in this field that it became desirable to distinguish it with a name of its own from the other established fields of electrical knowledge.

The basic principle of electronics is the fact that substances will emit electrons under the influence of light, heat, ultra-violet rays, and other forms of energy. Some substances are far more active in this respect than others; but the same general rules govern them all. The electrons are torn loose from the atoms of which they normally form a part. In the open air they cannot go far, for the dense crowd of gas molecules that composes the atmosphere impedes their progress almost immediately. But if the emission is produced inside a high vacuum, their journey is less obstructed and they may wander an inch or more under their original impulse (Fig. 1). Even so, if no other force acts upon them, virtually all

of them return to the surface from which they were ejected, and there restore the electroactive balance.

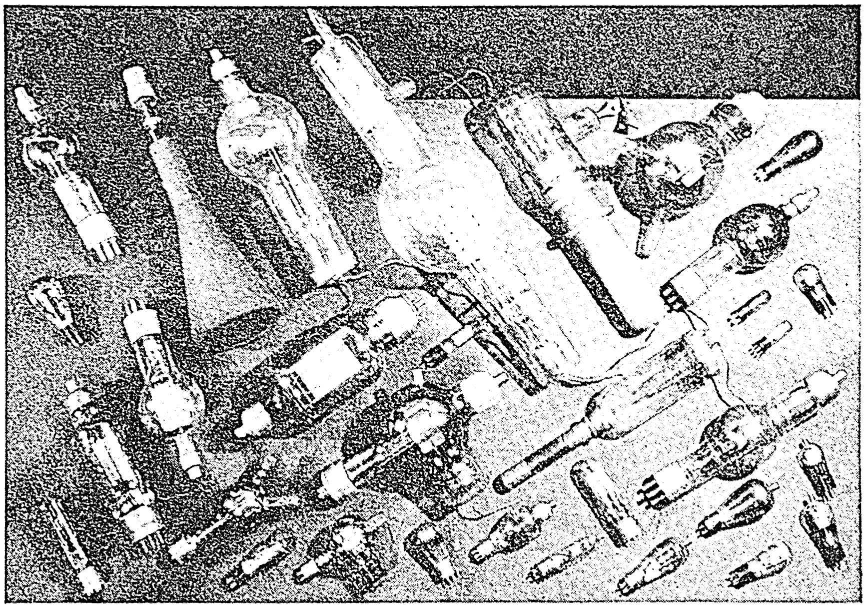
To understand this last statement, we must bear in mind that electrons are electronegative particles, that atoms consist of equal numbers of electrons and of electropositive particles called protons, and that therefore the departure of an electron from an atom leaves the latter with what is called an electropositive charge. If nothing interferes, the atom will draw back to itself the same or another electron to restore its balance.

That phrase, "if nothing interferes," is the key to the practical application of electronics. It is by interfering with the direct return of the wanderers that we turn them to our use. The methods of interference are generally the same for all types of electronic action, so we need not distinguish here between electrons driven out by heat, by light, or by other agencies; nor need we be concerned with the exact nature of the substance from which they are driven. Let us suppose that the surface which is emitting electrons is a metal plate sealed inside a vacuum tube but connected to a wire passing through the wall of the tube; and suppose that inside the tube also is another metal plate, similarly wired. Let us now join the two outside wires (Fig. 2). It is evident that a few of the electrons expelled from the first plate will strike the second plate by sheer accident of direction; but there is more than accident at work. The positive charge left on the first plate by the departure of electrons is transmitted around through the wire outside the tube to the second plate. This is in accordance with the ordinary laws of electric charges. This positive charge *attracts* to the second plate more negative electrons than would otherwise reach it; these electrons flow back through the wire to the first plate and *an electric current is set up.*

Helping the Electrons Across

With only the relatively feeble self-produced charge on the second plate, as shown in Fig. 2, many electrons that leave the first plate escape and never reach the second plate. The current in the circuit is, therefore, too weak and uncertain for practical use. But if we insert into the outside circuit a battery with its positive terminal connected to the second plate (Fig. 3), we can produce in that plate a positive charge so strong that virtually all the electrons that leave the first plate are irresistibly drawn to the second plate. The current that flows through the outside wire under these conditions is then a direct measure of the energy that is driving electrons out of the first plate. The measure of the intensity of light with a photoelectric cell depends upon this principle (*see* Photoelectric Devices). Another example of it is the increase in the volume of your radio receiver when you turn the knob that makes the tubes burn more brightly. The increased heat of the tube filaments drives off more electrons and allows more current to flow through them.

A FEW MEMBERS OF THE GREAT FAMILY OF ELECTRONIC TUBES



Among the uses of these tubes are radio transmission and reception, photoelectric recording and reproduction of talking films, the rectification of alternating current into direct current, the amplification of long-distance telephone messages and cable signals, the amplification of music or voices in theaters, lecture halls, and outdoor meetings, and the control of countless automatic machines and other devices. Different as they are in size and shape, all of them are based on the simple action illustrated on the opposite page.

Controlling the Electron Flow

The most interesting electronic feature of a radio tube, however, is the manner in which the feeble incoming signal, acting on the grid of the tube, transfers itself to the strong current of the plate circuit. The mechanism of this transfer is explained in detail in the Radio article, but its basic principle is graphically represented here in Figs. 4 and 5. When the grid is positive it adds its attraction to that of the plate, and while some of the electrons strike the grid and remain there, most of them pass through it of their own momentum and go on until they strike the plate. This maintains a large flow of current in the plate circuit. But when the grid is negative (Fig. 5), it opposes the movement of electrons to the plate, drives many of them back, and decreases the flow of current in the plate circuit.

We must repeat here briefly the warning that by an ancient convention, explained in the Electricity article, the flow of an electric current is almost always pictured as passing from the positive end of a

circuit to the negative end—in other words, in the direction contrary to the actual movement of electrons. In our drawings, then, although the electrons move clockwise around the circuit, the current is shown running the opposite way.

Applications of Grid Control

You can readily see how the extremely sensitive control of a relatively strong current by means of the grid of a tube, which acts like a valve to shut down or increase the flow, can be applied to many other purposes besides radio communication. The same kind of "amplification" of sound-carrying currents that is essential to radio is applied in the electric phonograph (*see* Phonograph), in "boosting" long-distance telephone messages and undersea cable signals (*see* Telephone), and in operating the type of sound or noise measuring devices called *acoustimeters*.

We have already noted that photoelectric cells or "photocells," as they are often called, are used to measure directly the intensity of light that falls on them. They, too, have an ever-increasing number of other applications. Among them are the making and reproduction of sound films, television, numerous automatic safety, counting, and sorting devices, and burglar and fire-alarm systems. (*See* Automatic Devices; Motion Pictures; Television.)

The general term for the negative electrode of a vacuum tube is *cathode;* the positive electrode is called the *anode*. When high voltage is applied to the tube, the electrons are drawn across the intervening space at enormous speed and strike the anode with so much energy that they partially disrupt its surface. This heats the anode and also, what is more important, causes the atoms on its surface to send out the type of radiation called X-rays. With the article on X-rays are pictures showing the special construction of the vacuum tubes that are used for this purpose.

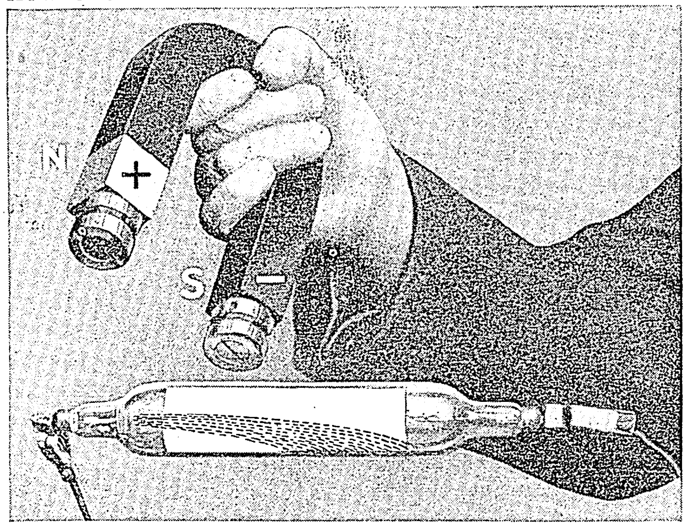
Electrons Form Cathode Rays

When X-rays were discovered in 1895 the nature of the energy that passed between cathode and anode was not understood. What we now know to be swiftly moving electrons were called "cathode rays." The name is still applied to any stream of electrons traversing a vacuum tube with sufficient velocity to cause appreciable disturbances at the surfaces they strike. Special tubes have been designed for experimental purposes that permit cathode rays to come out through thin "windows" and exert their powerful influence on external objects. These also are pictured and described in the X-ray article.

How the Oscilloscope Works

Other tubes have been devised to show how cathode rays are deflected from their straight path by a magnetic or by an electrical field. This deflection varies according to the intensity of the magnetic or electric attraction and repulsion. In the type of tube called a "cathode-ray oscilloscope" this fact is used to measure and analyze sounds or other types of vibration that may be carried by an electric current. At the large end of the cone-shaped tube is a chemically-treated screen on which a thin stream of electrons makes a small, brightly glowing spot. Within the tube are two plates, one on each side of the electron stream. These plates are connected into the circuit carrying the current to be analyzed. Any fluctuations of that current cause corresponding deflections of the electron stream, so that the bright spot moves rapidly *up and down* on the chemical screen. Acting at right angles to the two plates are electromagnets through which flows an independent current of regular alternations, so adjusted that the electron stream moves steadily *back and forth* across the screen. The result of this twofold motion traces on the screen a "wave pattern," showing distinctly the form and intensity of the vibrations to be analyzed.

HOW A MAGNET DEFLECTS A STREAM OF ELECTRONS



Set lengthwise down the middle of the tube is a card coated with a chemical that glows under the impact of electrons, so that in a darkened room the path of the electron stream is plainly revealed along the side of this card. The dotted lines show how the electrons are deflected downward by a magnet held in the position shown. This proves that electrons are negatively charged particles of matter.

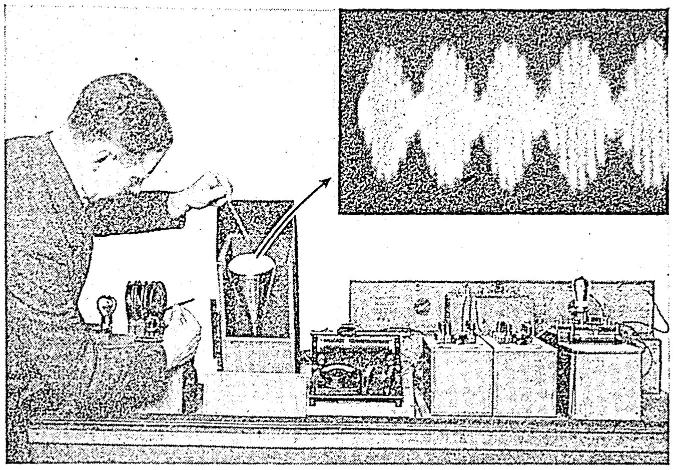
Electrical attraction alone is not sufficient to drag many electrons out of the cathode of a high-vacuum tube, even when high voltages are applied to the tube. That is why X-ray and cathode-ray tubes require a heated filament at the cathode end to supply the electron stream. But if the tube is only moderately evacuated, so that a considerable amount of air or other gas is left, the situation is altered.

The Mechanism of "Glow-Lamps"

The gas atoms and molecules are neither so densely packed that they cannot move around freely nor so few that their action is ineffective. Even before the voltage is applied to the tube, many of the atoms or molecules have become ionized as the result of collisions with one another, some losing electrons and

becoming positive ions, some gaining electrons and becoming negative ions. As soon as the voltage is applied to the tube, the positive gas ions move toward the cathode and the negative ions toward the anode. More collisions take place, knocking loose more electrons. Some of the positive ions, reaching the cathode, strike it so hard that there, too, electrons are torn loose. The net result of all this agitation is that a stream of electrons, either traveling alone or riding on gas particles, passes from cathode to anode. In the course of the electron exchange the gas particles emit light waves (*see* Radiation), producing a glow in the tube. This is the characteristic glow seen in Geissler tubes, Crookes tubes, the "glow-lamps" used in photoelectric devices and television, and the "neon" lights used in advertising (*see* Electric Signs).

HOW ELECTRONS "PAINT" WAVE PICTURES



The cone-shaped tube in the box is a cathode-ray oscilloscope. In the upper right-hand corner is the kind of image that appears on its upper surface when a current carrying a musical note is passed through the tube. The room must be dark to see this image clearly. The text explains how the electron stream produces its rhythmic pattern.

Control of "Space Charges"

Around the hot filament or light-sensitive surface of most vacuum tubes and photocells "space charges" tend to accumulate. These consist of crowds of electrons drifting uncertainly between the attraction of the opposite electrode and their natural tendency to return to the surface they have left. This naturally interferes with the emission of more electrons and weakens the action of the tube. In such tubes as the "thyratron" a number of gas atoms are allowed to remain intermediate in quantity between those in a glow tube and those in a high-vacuum tube. Many of these are turned into positive ions by impact and so move toward the cathode where they neutralize the space charge and permit more electrons to escape. Such tubes will handle much larger currents than the others.

The study of the behavior of positively charged atoms in vacuum tubes is outside the field of electronics proper. But it has proved of vast importance to scientific research. They constitute the so-called "positive rays" and by an arrangement exactly the reverse of a cathode-ray oscilloscope, these streams of positive particles have been separated into "mass spectra" which have given extremely accurate information about the atoms that compose them (*see* Radiation).

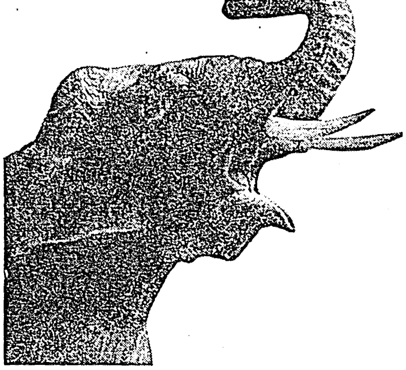
An important branch of electronics deals with the measurement of the electron emissions from various substances. Tungsten filaments in electric lamps for example, at their ordinary temperature when incandescent, 3,850° F., emit about 0.003 amperes of electricity in the form of electrons for each watt of energy used to light the filament. Other metals, such as the alloy of tungsten and thorium often used in radio tubes, may emit from 15 to 20 times this quantity. As the article on Photoelectric Devices points out, similar variations exist in the number of electrons that are driven from the surface of various substances by light energy.

ELECTROPLATING. The thin coating of gold, silver, or nickel that is so much used to ornament or protect table cutlery, watch cases, bag fittings, stove trimmings, and hundreds of other articles, is applied by what is known as "electroplating." This process is based on the principle that most liquids are decomposed when an electric current is passed through them (*see* Electricity; Electrochemistry).

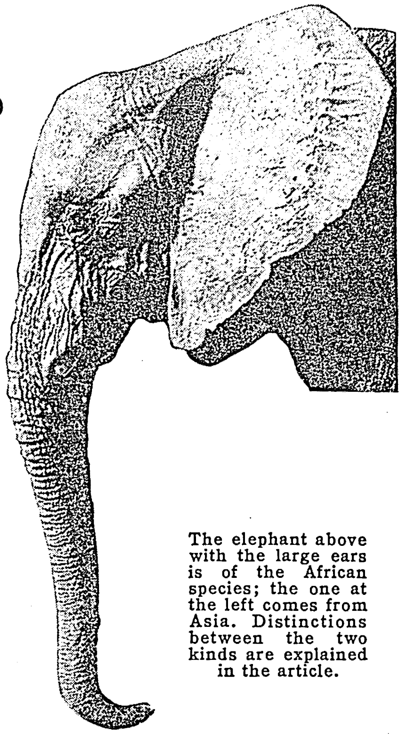
The article to be plated is cleaned and suspended in a solution of the "salts" of the metal which is to form the coating. It is connected to the negative terminal of a battery, and a bar of the metal to be deposited is connected to the positive terminal. The solution is thus decomposed and the metal it contains is deposited in minute particles on the article. These particles are replaced in the solution by others dissolved from the metal bar at the positive terminal.

ELECTROTYPING. The principle of electroplating is also used in producing "electrotypes" for printing. By this process copies of type pages, engravings, etc., are made in copper (sometimes nickel), to be used on the printing press. A mold, usually of beeswax or ozokerite, is first made of the type or engraving. The mold is dusted with graphite to make it a conductor of electricity, then suspended in the bath, generally a solution of sulphate of copper. The process proceeds as in electroplating, until a thin copper plate is formed over the wax. When this plate is as thick as a stout sheet of paper, it is separated from the mold and strengthened by a backing of type metal, which is melted and poured on the back of the plate. Lead molds instead of wax are used sometimes for very fine work.

Books are printed for the most part from electrotype plates, because of their durability; newspapers use stereotyped plates, which can be made much more quickly and cheaply (*see* Stereotyping).



LONG-NOSED GIANTS *of* ASIA *and* AFRICA



The elephant above with the large ears is of the African species; the one at the left comes from Asia. Distinctions between the two kinds are explained in the article.

Character of Elephants and Their Social Life—The Story of Trunk and Tusks—The Two Great Tribes and Their Pigmy Relatives—Capturing Wild Elephants and How They Are Put to Work

ELEPHANT. The elephants are the largest living land animals. Giraffes are taller, but their bulk is much less. Adult Indian male elephants average about 4 tons in weight and 9 feet in height; the tallest reach 11 feet. African males are somewhat taller. They reach 12 feet in rare instances, though they are no heavier than the Indian species. The average height of the females of both species is about a foot less than that of the males.

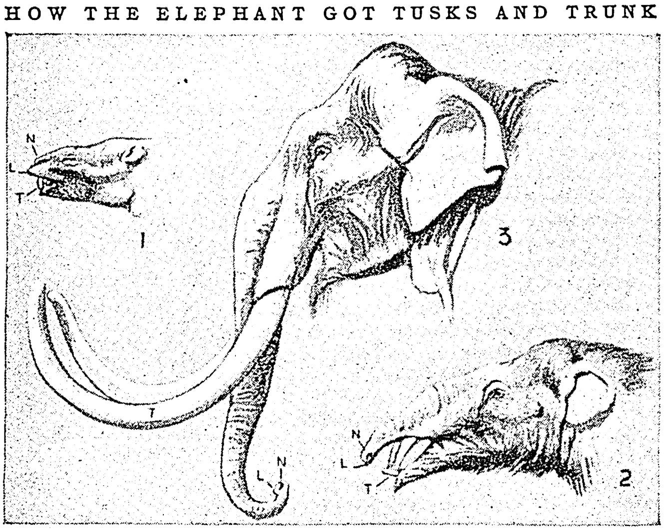
The great size of elephants and the thickness and toughness of their skins protect them from every other wild animal. Since they have no enemies to fear except man, they are generally peaceful, easy-going, and tolerant of smaller creatures.

Toward their own kind they show deep affection, and they usually spend their entire lives as members of a "family herd." This consists of several generations of blood relatives with occasional additions by mating from other herds. The typical herd contains from 20 to 40 members of all ages. Males ("bulls") and females ("cows") are about equal in number. The leader is usually an old cow. She is more likely to keep an even temper than a male, for males, peaceful though they are as a general rule, occasionally go mad during their mating periods. When a bull goes *must*, as the term is, he may in his blind frenzy try to trample down everything in the way. If he creates too much disturbance, his relatives drive him out of the herd. Usually he recovers and returns; but sometimes he becomes a solitary "rogue elephant"—one of those dangerous outcasts of elephant society which attack men or plow through native villages without provocation.

Except in cool, cloudy weather or when disturbed by hunters, elephants do not travel by daylight. During the hottest hours the members of a family herd huddle together in any shade they can find and sleep standing up. No one has ever reported seeing an African elephant lying down to rest in the jungle, though tame Asiatic elephants frequently rest in this way. Toward sundown the herd saunters to the nearest river or lake or waterhole to drink and bathe. At dark they all start out to feed.

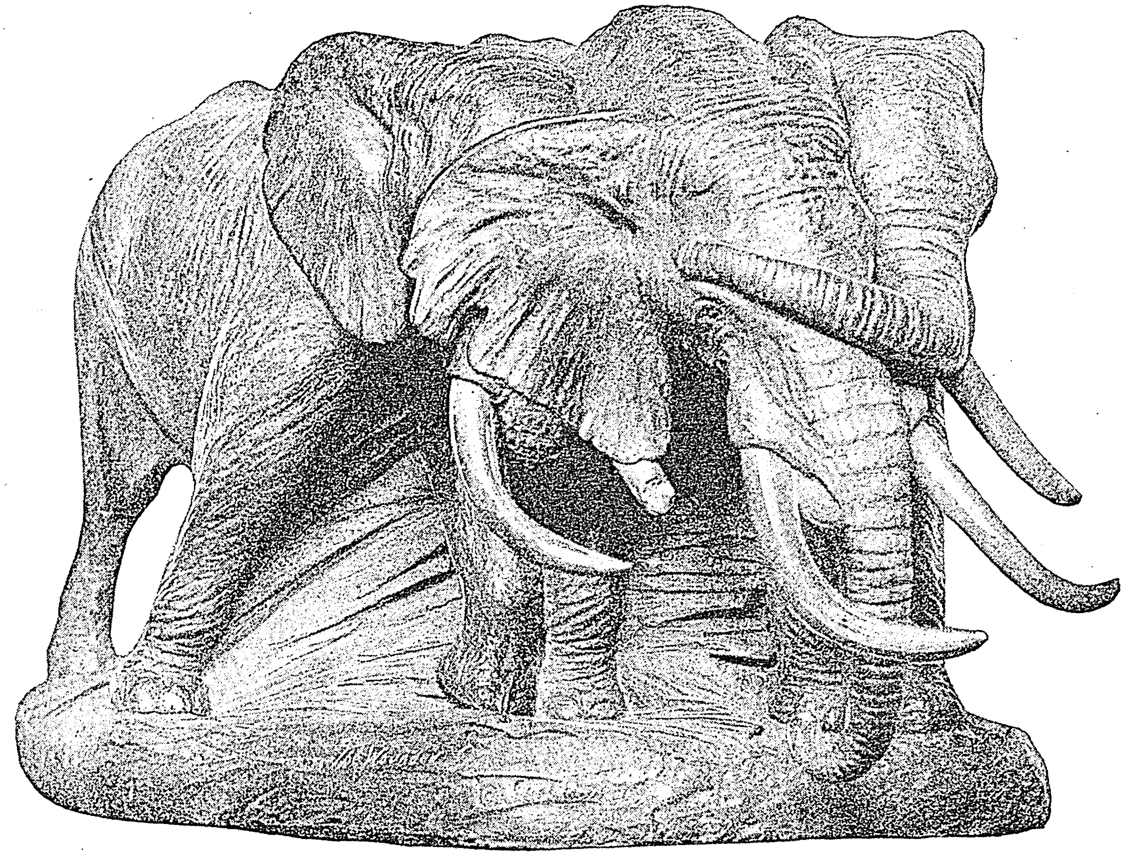
The pace is set so that even the very young and the very old can keep up. If a mother with a baby falls behind, her mate and several other members of the herd will remain to pro-

HOW THE ELEPHANT GOT TUSKS AND TRUNK



The Elephant started several million years ago, with a tapir-shaped head. The drawing (1) is based upon a fossil found in northern Africa. As ages rolled on, the upper lip, still carrying the nostril, grew longer and drooped, while the "eye teeth" commenced to sprout out into tusks (2). This development reached its height in the mammoth of Glacial times (3). The modern elephant is a smaller variety of the mammoth type. The letters "N," "L," and "T" indicate the position of "nostrils," "lips," and "tusks" in each case.

HELPING A "WOUNDED COMRADE"



This well-known statue group of elephants by Carl Akeley stands in the American Museum of Natural History in New York City. It shows two elephants supporting a wounded comrade between them. Elephants are social animals, and it is their habit to stand by each other in danger.

tect them. A male and female, once mated, will usually continue to travel together. Their attachment, naturalists believe, endures as long as they both live.

As the herd straggles along, the elephants push down young trees with their shoulders and chests or uproot them with their tusks to feed on the tender roots, twigs, and leaves. In the open meadows they gather up tufts of grass with their trunks and stuff them into their mouths. At times a herd will invade the fields of natives to feed on bean plants, millet, banana trees, and other crops, but it will never enter villages or destroy huts. Only the solitary rogue elephants do this.

A herd may range over a fifty-mile radius in the course of a single season. Seldom does it sleep in the same place for two days in succession. Bulls of different herds occasionally fight when they meet, but usually herds mingle on friendly terms. Many pictures have been taken from airplanes showing vast elephant armies made up of many family herds traveling over the same route toward new feeding grounds.

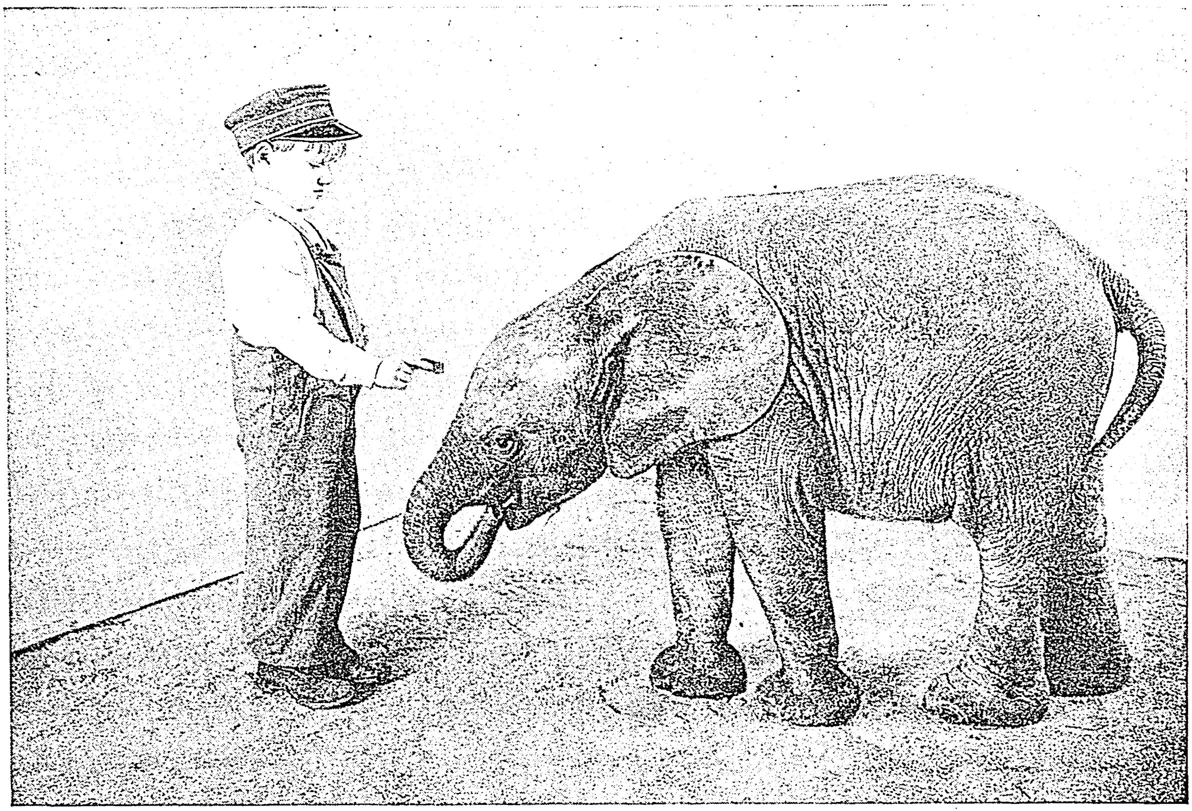
At birth the baby elephant is about 3 feet tall and weighs about 200 pounds. It has a sparse coat of woolly hair, which gradually disappears. It takes its mother's milk with its mouth and not, as some people imagine, with its trunk. The young elephant is nursed by its mother for about two years and remains under her protection for two years more. The period between mating and the birth of a young elephant is about 22 months. Thus female elephants as a rule bear young not oftener than once every four or five years.

Structure of Elephants—The Trunk

Trunk, tusks, and feet are the elephant's most conspicuous features. The trunk is a prolongation of nose and upper lip combined. The two tubes of the nostrils, surrounded by muscle, run the whole length. The trunk is an extraordinarily powerful and yet delicate instrument. With it the elephant can break a large branch from a tree or pick up a peanut. The upper side is tough and is often used for pushing, but the under side is very sensitive.

The elephant guards his trunk carefully and never strikes down with it in fighting. The common idea that he uses his trunk in this way arose from the attitude he takes when he suspects danger. Because his eyesight is poor, he relies for warning on his keen senses of smell and hearing. Hence, when he is suspi-

A YOUNG "ROUND-EARED" OR "PIGMY" ELEPHANT



This is "Tiny" photographed with a keeper's son when she first reached the New York Zoölogical Park. Her height was 3 feet, 7 inches, and she weighed 425 pounds. Her age was estimated at three years. She lived at the zoo for eleven years and accumulated a weight of 2,500 pounds before she died. Notice the round ears that are characteristic of the pigmy species. The photograph also shows clearly the spreading, pad-like front feet that all elephants possess.

cious, he raises his ears to catch the slightest sound and thrusts his trunk outward to probe the air with noisy sniffs. But when charging or defending himself, he curls up his trunk out of harm's way.

The elephant drinks by drawing water half-way up his trunk and then squirting it down his throat. He can draw in corn and other grain and blow it into his mouth in the same way.

The Useful Tusks

The lower jaw has no front teeth, and the upper jaw has only one pair. It is these two teeth, corresponding to incisors, that grow so long and form the tusks. They are "second teeth" which grow out after the baby elephant's tiny milk tusks are shed. The ivory of which they are composed is pure dentine, with a short cap of enamel at the tip which is soon scraped off (*see* Ivory; Teeth).

The tusks keep on growing as long as an elephant lives. If he uses them a great deal, they wear away at the points as they grow at the roots. Because one tusk is likely to be used more than the other in digging up roots, the two are seldom of equal length. The heaviest known single tusk weighs 235 pounds; the longest measures 11 feet, 5 inches. These are freaks. A tusk weighing 100 pounds is well above the average for African elephants; the average for Asiatic elephants is much less. An elephant burdened with very heavy tusks may have to abandon the family herd because their weight prevents him from keeping up.

There are six molar teeth on each side of the upper jaw and six on the lower jaw; but never more than one or two of the six are in use at the same time. As those in front are worn away, the successively larger molars behind come into place. Thus an old elephant may be left with only a single huge molar above and one below on each side.

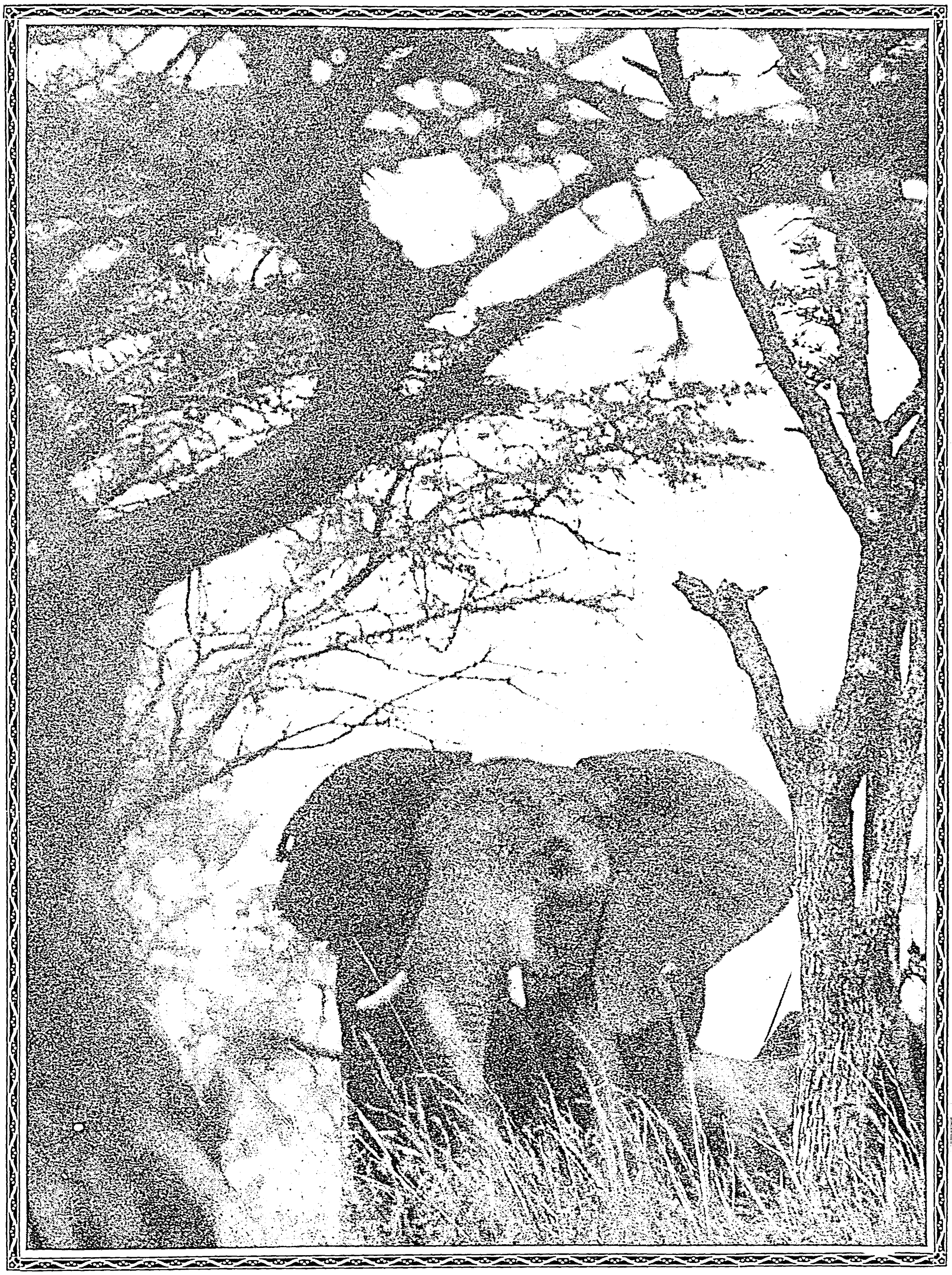
The Elephant's Padded Feet

An elephant's foot closely resembles the *plantigrade* foot of man (*see* Foot), except that the heelbone rests on a thick pad of flesh. Thus the elephant's hind leg has no conspicuous heel or hock joint as does the hind leg of a horse or dog. The free joint is the knee, and the elephant is one of the few animals that can kneel on its hind legs.

When the elephant walks he sets his hind feet down in the track left by his front feet. Picking his way with amazing silence through a forest, he needs to watch only where he puts his front feet. In deep mud or bog his flanged feet spread out as they go in and contract as they come out, so they do not stick.

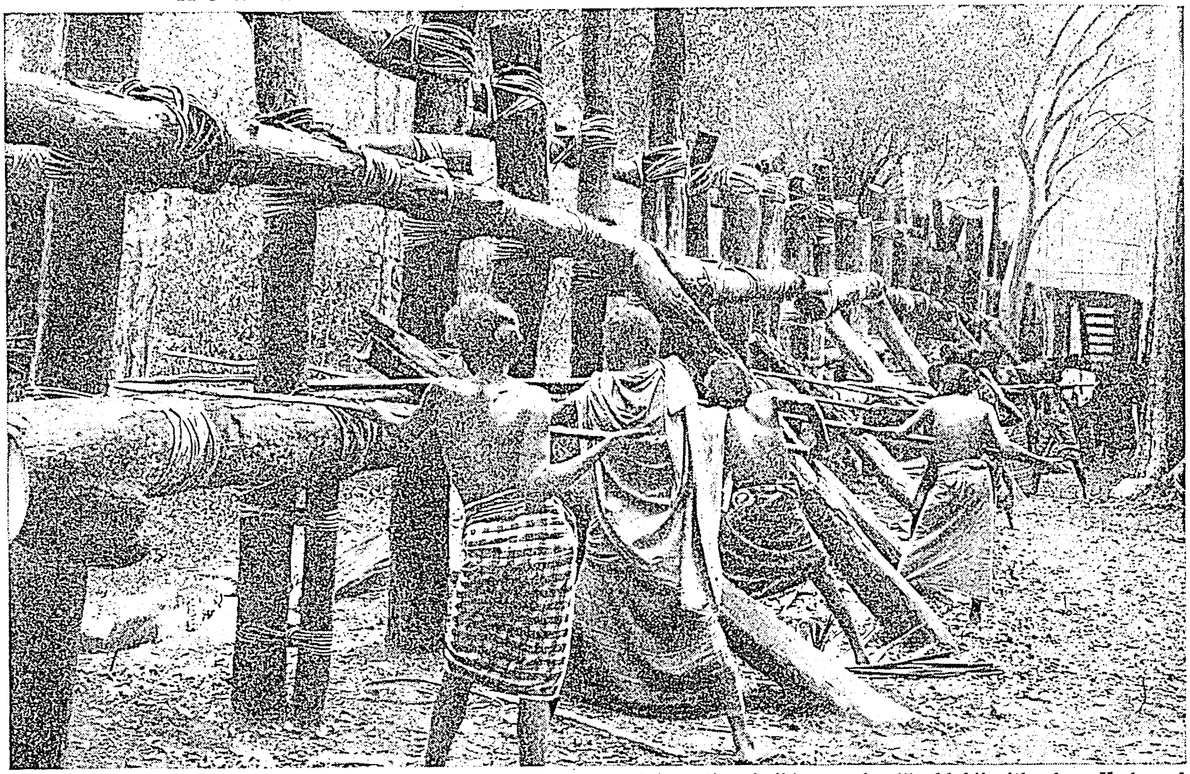
Elephants are not fast runners. Fifteen miles an hour is near their limit, about half the speed of a

NOW IT'S TIME TO CLIMB A TREE



The person who knows the Elephant language will always start hunting a place of safety when he sees an Elephant looking like this. This is a mother African Elephant who was hastily snapped by the photographer, just as she had made up her mind that her young son was in danger. The sign of warning is the spreading of the ears accompanied by trumpeting. A second after this picture was taken the Elephant charged, but the bold picture man had dodged safely out of view.

HOW WILD ELEPHANTS ARE CAUGHT IN ASIA



To make ready for an elephant round-up in the jungles of Southeastern Asia, natives build a corral or "keddah" with a long V-shaped approach. Heavy posts, braced with beams, and bound with rattan, form the stockade. Then beaters surround a wild herd, and with a frightful hubbub of shouting drive it towards the pen. Bellowing furiously, the animals charge blindly down the runway into the trap, while outside, natives with long poles prod the captives back from the walls to keep them from plunging through.

good running horse. They are, however, singularly agile, despite their bulk, in climbing up and down hills. Their running gait is the same as their walk —a shuffling stride. They can neither trot, gallop, nor jump. A deep ditch only seven feet wide stops them, for this is wider than the longest stride they are able to take. They are, however, at home in deep water, and can swim for six hours at a time. They sink almost out of sight, with the trunk held up high for air.

Only the rhinoceros, the hippopotamus, and the tapir have hides as thick as the elephant's. That is why these animals are called *pachyderms*, which means "thick-skinned." The hide on an elephant's shoulder may be an inch and a half thick. All over his body it is loose and wrinkled. On the tail grow long coarse hairs larger than the lead in a pencil. These hairs are made by natives into rings and ornaments.

Contrasts in African and Asiatic Species

On the forefoot the African elephant has four nails; the Asiatic elephant, five. On the hind foot, the African has three nails; the Asiatic, four. The African elephant has two nipple-like "fingers" on the tip of its trunk; the Asiatic elephant has only one. The surface of the African elephant's trunk is divided crosswise into pronounced ridges and grooves; the trunk of the Asiatic elephant is smoother. The African elephant has much larger ears and holds its head higher than the Asiatic elephant. Virtually all African males and most females have tusks; many Asiatic males and nearly all females are tuskless.

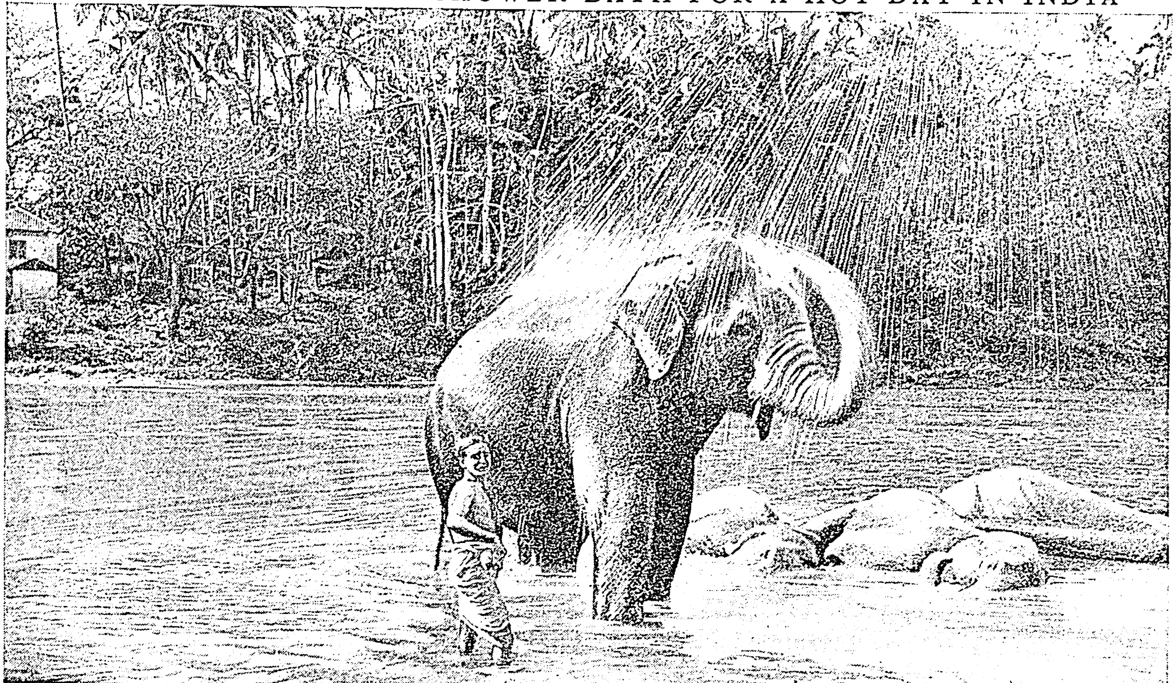
Before the white man began to settle in Africa, the African species ranged over the whole tropical region from sea level to the timber line of such snow-capped peaks as Kilimanjaro and Ruwenzori. Today elephants are plentiful only in the less settled central and eastern sections. The range of the Asiatic elephant extends through the forested parts of Ceylon, India, Burma, Thailand, Cochin-China, and down through the Malay Peninsula to the island of Sumatra.

The Pigmy Elephants and the Albinos

A third species of elephant is the "round-eared," or "pigmy," elephant, found in Liberia and the Cameroon Mountains. These differ from the African species chiefly in size and the shape of the ears; but they are not so small as the name "pigmy" implies, for they reach a height of six or seven feet and a weight of more than a ton.

The "white elephants," occasionally found in Asia, are not a separate species but merely albino varieties of the common species. Elephant worship plays a part in several oriental religions. The white elephant, however, is particularly venerated in Siam. Until recent years it was pictured on the Siamese flag.

A "SELF-STARTING" SHOWER BATH FOR A HOT DAY IN INDIA



In the wilderness or in captivity elephants like their daily bath. Notice how the one standing up here is throwing water over himself with his trunk. Kipling has told a "Just-So" story about how the elephant got his trunk. "A hungry crocodile grabbed the nose of a too-curious little elephant and in the struggle that followed pulled it out long. The other elephants laughed at the funny new nose of the little elephant until they saw how useful it was and what fun he had squirting water with it. Then they all went to the crocodile and had their noses stretched, too."

Though it has been said that elephants live as long as 150 years, there is no actual record of any such age. Sixty years is believed to be the maximum length of life in captivity. Stories have been told of "elephant graveyards" to which all the elephants from the surrounding country go when they feel death approaching. Ivory hunters have searched in vain for these "graveyards." Perhaps the legend arose from the fact that African natives set fire to the grasslands to clear the ground for cultivation, and thus may occasionally cause the death of a whole herd.

The use of elephants as beasts of burden in peace and war can be traced far back in history. The elephant corps attached to Hannibal's army is famous (*see* Hannibal). We do not know how the ancients obtained their elephants. Today the "keddah" system of capture, shown in a picture with this article, is the chief method employed in India and neighboring countries where "work elephants" are most in demand.

After capture, two tame elephants close in on the wild one and hold him until men can hobble his feet with ropes. The next step is to get him used to the presence of a "mahout," or driver. Feeding, friendliness, and firm discipline, plus the example of the tame elephants, soon complete the taming.

Elephants in Captivity

The elephant is a striking exception to the rule that wild animals captured when full grown can rarely be domesticated. Most elephants that are used as beasts of burden, as well as those in zoos and circuses, were born in the wilderness and remained there until they were ten or twelve years old. There are several reasons for this. Elephants do not breed readily in captivity, and the young are delicate and hard to raise. Furthermore, a baby elephant matures very slowly and meanwhile eats enormous quantities of food. Thus it is cheaper to let him grow to useful size in his native haunts and then to catch him and tame him. The elephant's extraordinary docility makes this possible.

The record made by Carl Hagenbeck, the famous German animal dealer, is an extreme example of this docility. Within two days he trained six African elephants which had never been worked before to carry loads and their drivers. Hagenbeck and many other experienced men say that there is no foundation for the belief that the African elephant is more savage and dangerous, or less easily trained, than the Asiatic elephant. In recent years many elephants have been trained to work in the Belgian Congo.

In his work an elephant may be called upon to push heavy burdens with his head, to pull with a harness, or to drag logs with a cable which he holds in his teeth. If he has tusks, he may use them in various ways; but he never pulls loads with his trunk.

In India, elephants are sometimes used in tiger hunts. The hunter takes his place on a platform saddle, or "howdah," strapped to the elephant's back and beaters range through the jungle to drive out the tigers. When the great cats draw near, the elephant

gives warning, and so prepares the hunter for his shot. The chief danger to the hunter, it is said, is on the rare occasions when a wounded tiger leaps on an elephant's back, and the elephant madly runs under overhanging tree branches to get rid of his attacker.

In captivity as in the wilds, female elephants are the more steady and trustworthy. Males are seldom found in circus herds. An exception to this was Jumbo, the huge African male made famous by P. T. Barnum, the showman. When Jumbo was killed in a railway accident in Canada in 1885, he was about 25 years old and measured 11 feet, 2 inches. His skeleton is mounted in the National Museum at Washington, and his stuffed skin is preserved at Tufts College near Boston.

The elephant's usual willingness to obey commands has given him a reputation for great intelligence, but many animal trainers and keepers of zoos question this reputation. They point out that the elephant's brain is relatively small. Whereas he is credited with a good memory for people and places, he is subject to blind panics in emergencies. His vengefulness has also been exaggerated. A mad elephant is said to be as dangerous to a friendly keeper as to a cruel one.

Elephant Hunting

Elephants are protected by law in most regions where they are found today. Special licenses to hunt them must be obtained. Opinions differ about the danger involved in elephant hunting. Usually a herd flees from the hunter. If surprised at close range, however, both males and females are likely to charge. They try to trample the hunter down and pin him to the ground with their tusks. Because of the elephant's poor eyesight a hunter is usually safe if he can get higher than the elephant's line of vision by climbing a tree or scaling one of the great termite mounds that are common in elephant country.

Ancestry of Elephants

Scientists have traced the ancestry of present-day elephants back through a long chain of similar animals—some large, some very small—to the Tertiary period several hundred thousand years ago (*see* Geology). The mammoth and the mastodon are comparatively recent types that have a common ancestry with the elephants (*see* Mammoth and Mastodon). The nearest existing relatives of elephants are the water-dwelling manatees (*see* Manatee).

Elephants belong to the family *Elephantidae* and the order *Proboscidea*. Scientific name of Asiatic elephant, *Elephas maximus;* of the African elephant, *Elephas* (or *Loxodonta*) *africanus;* of the pigmy elephant, *Loxodonta cyclotis*.

ELEVATOR. Suppose we had to climb the stairs to the top of a building 40 or 50 stories high. If we could keep on steadily without stopping, it would take us nearly half an hour. But the high-speed elevator can take us there in one minute. It is this that makes possible the tall buildings of today.

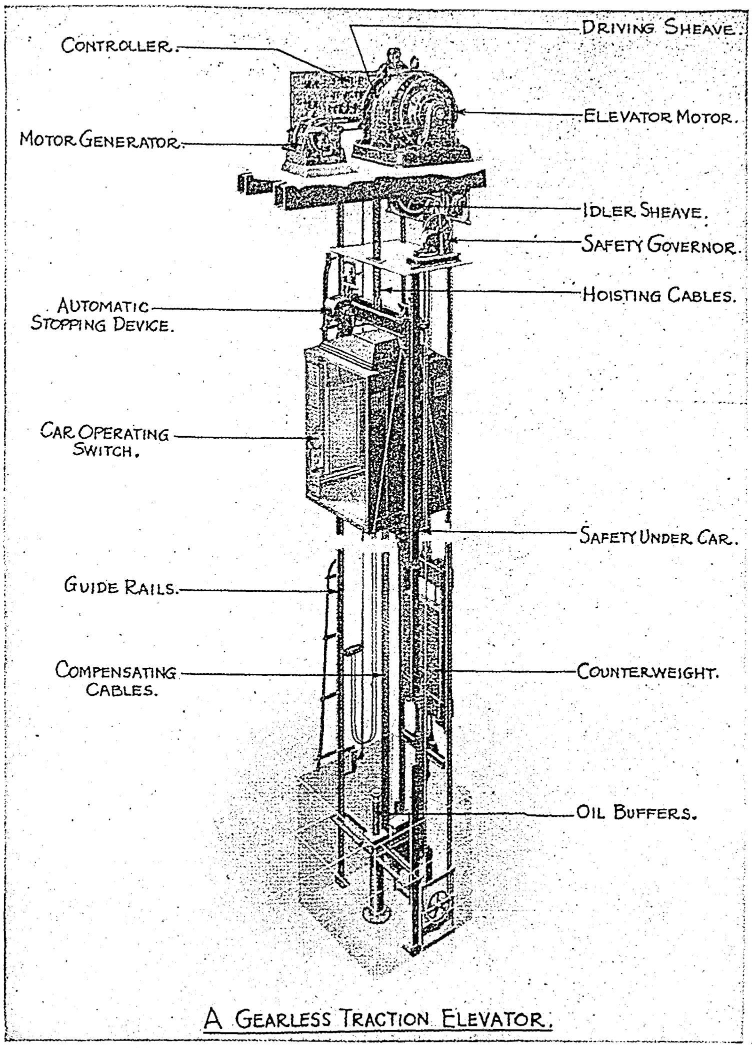
The construction of these machines is not complicated. Strong cables, with the car at one end and a counterweight at the other, pass over two pulleys, or sheaves, at the top of the shaft—first over the driving sheave, then over the second or "idler" sheave, and back over the first, making a complete loop. Wound like this, the cables cannot slip; for the greater the weight, the tighter they pull. The counterweight weighs about as much as the car with an average load, so that the motor has only to lift the excess load. The weight of the steel cables—a considerable item—is balanced by a number of compensating cables attached to the bottom of car and counterweight, and passing under a sheave at the bottom of the shaft. The motor which turns the driving sheave in either direction is operated by a switch. A brake, consisting of leather-faced shoes acting on a brake pulley, holds the car at any point where it is stopped.

What would happen if the car should fall? It is not likely that it will, for six stout wire hoisting cables are generally used, each of them strong enough to hold up the weight of the car. But there are powerful steel jaws on the bottom of each car which reach out and grasp the rails on which the car rides, if the speed reaches a certain high rate. The brakes also set automatically when the power is shut off. In addition, cushion buffers are placed at the bottom of the elevator shaft to break the fall, should the other safety devices fail. These buffers consist of plungers fitted into tight cylinders filled with oil. If the car or the counterweight strikes the plungers, the oil is slowly driven from the cylinder into the outside casing, and thus the descent of the car is checked. In one type of elevator, called the "micro drive" elevator, the controller automatically stops the car level with the floor landing if the operator does not gauge his distance exactly right. A development of this is the "signal control" type, in which the attendant presses buttons for the various stops instead of working a hand lever. This type also stops automatically at floors where passengers press a signal button. For small buildings there are elevators which are operated in the same way by the passengers and do not require attendants. Some "dumb waiters"—small elevators for sending dishes, etc., from one floor to another—are similarly operated.

The moving stairway, or "escalator," is another form of elevator used chiefly in elevated railway stations, subways, and department stores. It consists of steps connected so as to move continuously. A hand rail moves along at the same speed.

In one type of hydraulic elevator the car rests on a hollow pipe, which fits closely into a cylinder sunk into the ground as deep as the building is high. Two openings in the pipe let the water out and in. When water is forced into the cylinder, the plunger, carrying the car and the passengers, is forced upward. The water pressure is cut off when the car has gone as high as desired. When the operator wishes to descend, the outlet pipe is opened and the car sinks as the water escapes from the cylinder. A counterweight is used to reduce the amount of pressure that is needed. Elevators of this type cannot be used for very high

IT MAKES SKYSCRAPERS POSSIBLE



This is the marvel of ingenuity that whisks us up 40 or 50 stories in a few seconds. Without its aid we should have no tall hotels or office buildings.

buildings, more power is needed for operation, and their speed varies with the load. Another type of hydraulic elevator has a smaller cylinder, and the plunger, instead of being connected with the car itself, is connected with cables and pulleys, so geared that the car travels much faster than the plunger.

Elisha Graves Otis, in the early '50's of the last century, is credited with the invention which made the modern elevator possible—a device which prevents it from falling if the cable breaks. He also introduced a reversible steam engine directly connected to the hoisting machinery, which raised the car by winding a rope over a cylinder. In 1878 a hydraulic lift elevator was installed in the Boreel Building, New York City, and opened the era of modern elevators.

For many years the hydraulic type was supreme in the field, and even today finds considerable favor for handling heavy freight. For general use, however, the supremacy has passed to the electric elevator, the first of which was designed and built in 1884. The first important installation was in New York in 1889. The direct-traction elevator, in which an "endless" cable passes over a driving sheave instead of a single cable being wound around a drum, was developed about 1904. Various automatic devices followed. Recently new safety devices have been invented which permit the operation of two elevators in the same shaft at the same time.

ELIOT, Charles William (1834–1926). When Charles William Eliot was made president of Harvard University in 1869, "higher education" emphasized principally mathematics and the classics. Eliot, eager to give every student an opportunity to discover and develop his individual abilities, broke down this traditional system, which tended to force every student into the same mold. He brought new subjects into the curriculum, introduced the elective system, abolished compulsory religious worship, made it possible to complete the work for a bachelor's degree in three years, and built up a first-rate graduate school. He was an active member of several educational associations, and his writings, speeches, and correspondence were influential in bringing about reforms in the elementary and secondary schools. Eliot's activities are largely responsible for the development of present-day "progressive" educational methods.

He attended the Boston Latin School, and entered Harvard when he was 15. After his graduation in 1853, he taught for several years at Harvard and the Massachusetts Institute of Technology. He also spent several years abroad studying European educational methods before he became president of Harvard, an office which he held from 1869 until 1909. Throughout his long career, Eliot wrote and spoke extensively on educational, political, economic, and religious questions. He gained wide fame for his "five-foot shelf" of books, better known as the 'Harvard Classics'. This grew out of a remark of his that "all the books needed for a real education could be set on a shelf five feet long." A publisher asked him to select such a "shelf." He did so, and the collection has had a tremendous sale.

Dr. Eliot's principal books are: 'Five American Contributions to Civilization, and Other Essays' (1898); 'More Money for the Public Schools' (1903); 'John Gilley' (1904); 'Four American Leaders' (1906); 'The Durable Satisfactions of Life' (1910); 'The Road Toward Peace' (1915).

GEORGE ELIOT, *England's* GREATEST WOMAN NOVELIST

ELIOT, GEORGE (1819–1880). Mary Ann Evans, better known to us by her pen name of George Eliot, was born in Shakespeare's county, Warwickshire, Nov. 22, 1819. She spent the first 22 years of her life at Griff House on the Newdigate estate of which her father, Robert Evans, was agent. From 1841 to 1851 she lived at Coventry with her father, and then she moved to London as assistant editor of the *Westminster Review*. In 1854 she joined her life to George Henry Lewes, with whom she lived until his death in 1878. She married John W. Cross in May 1880 and died the same year, Dec. 22.

England's greatest woman novelist spent her childhood and youth in the same peaceful countryside which Shakespeare had known nearly three centuries before, and like him she grew up near the Forest of Arden. Like him, she entered life at a time when new forces roused mankind to achievements that made glorious the reigns of Elizabeth and Victoria. Six months younger than Victoria, she shared with the Queen the reawakening and the growth of the 19th century. With Thackeray and Dickens she contributed to its most worthy fiction.

GEORGE ELIOT AT FORTY

Lines of sadness are etched deep in this portrait of the great novelist, drawn by Samuel Lawrence in 1860 when she was just rising to fame with 'Adam Bede' and 'The Mill on the Floss'. Her only beautiful feature was her abundant hair.

The dominant trait, the ruling passion, of her life was sympathy, sympathy allied with passion to serve. In her childhood, sympathy urged her to share her brother Isaac's sports, to understand her sister Chrissy's heart, to cherish her mother's frail body, to observe her father's duties while riding with him about the estate, and to treasure stories of his youth. All the members of her family she later enshrined in her novels. Isaac is Tom Tulliver in 'The Mill on the Floss', perhaps of all her books the best loved by boys and girls. In 'Middlemarch', which to many critics is the greatest of her works, Chrissy is Celia and her father is Caleb Garth. In 'Adam Bede,' which the author felt to be the truest of all her novels, her mother is Mrs. Poyser, so far as the pungent speeches are hers, and her father is Adam Bede. At boarding school, before the age of ten she was nicknamed "Little Mama" by the girls who brought her their troubles. After leaving school at 16, on the death of her mother, she established clothing societies and helped in other ways her humbler neighbors. An ardent young Christian, she sat in the family pew and felt sorry for Mr. Gwyther, whose errors in English blinded her neither to his goodness nor to the inadequacy of his salary. And her heart ached for pretty Mrs. Gwyther, growing old under hardship. When she wrote her first story about the sad affairs of the Reverend Amos Barton, George Eliot turned back to that family for quickening of her spirit, felt again the compassion she felt for the clergyman and his children when Mrs. Gwyther died.

Early Studies

This feeling for others, with others, was heightened by her studies. Knowing her physical homeliness, the pale, long-faced, sandy-haired girl knew she had an excellent mind. With a passion for learning, she so extended her early education through tutors and by independent reading as to become one of the best women scholars of her day. More and more she recognized, as she read, that large souls have no kinship with the mean and sordid; constantly she guided herself by good books. On thought, and love that vitalizes thought, she was advancing through sympathy with all humanity toward larger service.

Loving Service of Others

While keeping house for her father, after Chrissy's marriage, she learned languages, music, science, philosophy; but, never too weary to comfort her father, she read aloud to him or played to him from the German composers they both loved. She had time too for the Perkins children across the road, to whom she gave

her outgrown toys and with whose family she often drove to church. When her brother Isaac married and undertook the management of Griff House and farm, Mary Ann moved with her father to Coventry. Here one of her first efforts was to convert Charles Bray, a leading citizen of the town, to Christianity. Not surprisingly, in the new freedom of thought which was shortly to include Darwin's theory of evolution, Marian (she now wrote her name so) was herself converted to Bray's philosophy. His was the doctrine of consequences, resting on the logic of cause and effect: if you sow good, you will reap good; if you sow evil, you will reap evil. All George Eliot's novels emphasize this and similar doctrines. She rejected the historical Christ, but, to the end of her life, accepted the spiritual Christ. Throughout three long years consumed by translating Strauss's 'Life of Jesus', she raised her eyes to a small statue of Christ, for frequent inspiration in construing the unwieldy German into beautiful English.

New Work and New Friendships

Alone, Marian nursed her father through his long illness, so closing the first phase of her life by devotion to family, love for neighbors, passion for truth. In Switzerland, where she went for rest, she entered into the occupations and interests of all at her boarding houses. When she returned to England in 1851, she began her career in London as assistant to John Chapman, editor of the *Westminster Review*. Allying herself, as always, with the cause of another, Marian labored 18 hours a day on the periodical, which became under her guidance the most enlightening literary journal of the day.

Despite her outflowing generous nature, Marian had met few men and women of the world of letters. Now she flowered, notwithstanding mountains of work, in a setting that brought her into relations with leaders of advanced thought. Soon she met Herbert Spencer, and formed a stimulating friendship that lasted to the end of her life. By Spencer she was introduced to George Henry Lewes.

Lewes's wife had deserted him, leaving with him their three young boys. Marian's compassion, roused by the man and his motherless children, merged into love. In discovering these four who needed her, she found herself, found also in Lewes a man who cared most for those things of the mind for which she most cared, found a bright, sunny nature that complemented her own. For, bearing the burdens of others a long while, she was a woman of sadness rather than joy. Now she could relinquish herself to happier work, in a new companionship of soul. In 1854 she joined Lewes in a union that lasted until his death. Marriage was impossible because under English law at that time Lewes could not get a divorce without insurmountable difficulty.

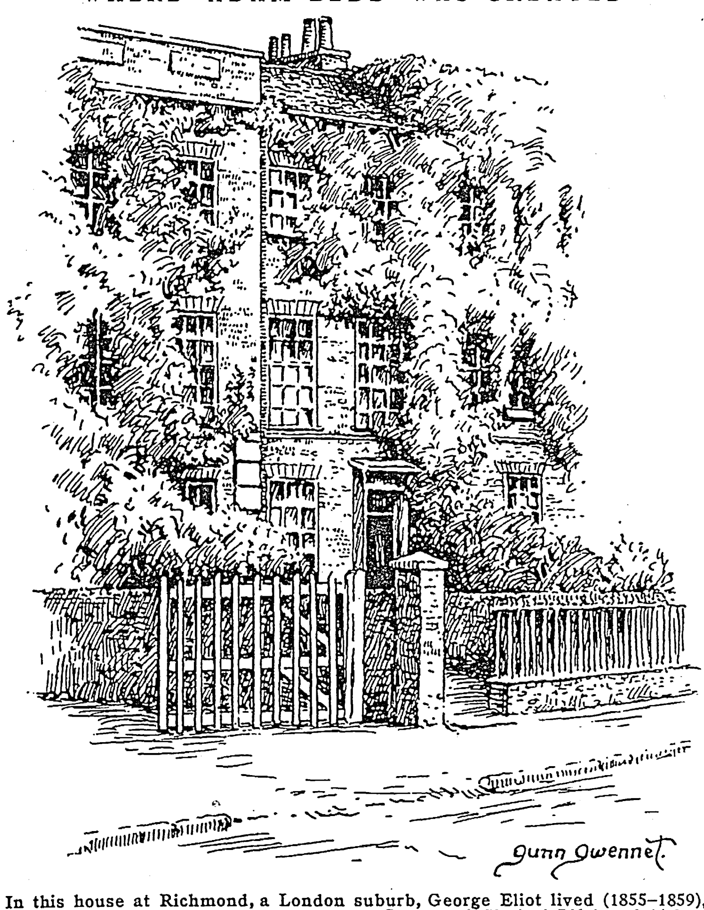
Into this union, Marian threw all the forces of her slight body and magnificent brain. Lewes's name was better known than Marian's; he was a writer of established journalistic reputation while she, though ably doing the labor of two men, was an underpaid drudge. At first she wrote articles that helped to fill the family purse, while encouraging Lewes in his 'Life of Goethe' and traveling with him in Germany.

Her Career as a Novelist

Associated daily with this amazing woman, Lewes watched her literary growth, watched her genius unfold, and recognized with rare generosity that hers was the superior ability. Before they left Germany he was urging her to write fiction; soon he was helping her. She who had lived so long for others was to experience the joy of another's living for her. When she chose a man's name under which to publish her first novel, she said, "George, of course." And then she silently added, "To L—I owe it," and converted that phrase into "Eliot."

On their return to England in 1855, Marian and

WHERE 'ADAM BEDE' WAS CREATED



In this house at Richmond, a London suburb, George Eliot lived (1855–1859), and here she created and largely wrote 'Scenes of Clerical Life' and 'Adam Bede'. The site is now occupied by the Public Health Department buildings. A memorial tablet has been placed on the door of the guardian's office.

Lewes, who were helping relatives on each side of the family, sent the boys to school in Switzerland. This expense demanded work and more work; but all they asked was time for writing. Now began the series of stories and novels which soon put the name of George Eliot high in the list of Victorian writers.

Old Friends Portrayed in Her Novels

In her first tales Marian turned to her earlier days and portrayed not only every member of her family but many of the others she had known while living at Griff House—the clergymen, the humbler folk, and, of the upper classes, the Newdigates. For the marvelously created children dancing through her pages, she relied upon memory of those she had loved when young. The very animals of her past came to life again—more than a score of dogs frisk through the novels.

Later, she drew upon the Coventry days, using her old friends Cara Bray and Sara Hennell in 'Daniel Deronda'; upon the time in Germany when she had met, among others, Liszt the musician, who figures as Herr Klesmer in the same book. All English middle-class life she requisitioned for 'Middlemarch', where she is represented by Dorothea and Lewes by Ladislaw. Out of visits to Spain came self-sacrificing Fedalma, of 'The Spanish Gypsy'; from visits to Italy emerged the historic Savonarola of 'Romola'. In these two works she had passed beyond the bounds of England. Finally, from sympathy with a race often misunderstood and persecuted, she capped her pyramid of fiction with the character of Deronda, the Jew.

All her books emphasize unselfishness, loving-service. Romola became free in helping others; Silas Marner found his life through devotion to Eppie; Felix Holt developed through his wish to improve conditions of workingmen. Opposed to these generous natures are selfish men and women: Donnithorne, the betrayer; Grandcourt, the gentleman villain; Hetty, the vain beauty; Rosamond, the wilful; Gwendolyn, the spoiled weakling—all foils for nobler characters. The characters reap what they have sown, good or evil.

After Lewes's death (1878), Marian lost all desire for living and, for months, refused to leave the house. At length (1880), she became the wife of John W. Cross, a friend of many years. But her genius had died with Lewes; after a few calmly happy months, she followed him and was buried by his side in Highgate Cemetery. Cross survived her by more than 40 years.

Feeling, passionate feeling for others, then, explains her life as it explains her fiction, from the early days when she was called "Little Mama," through the years of her fame when she re-created scenes and people of lovely Warwickshire, to the culminating period when her sympathy embraced not only her own race, her own nation, but a nation and a race other than her own. Her life was interwoven with dark threads of anxiety, sickness, and the death of all for whom she most cared; but, in retrospect, the somber shades effected a superb background for the warm hues of her sympathy, the gold of her loving heart.

Books By and About George Eliot

Chief Works: 'The Life of Jesus' (translated from the German of D. F. Strauss) (1846); 'The Essence of Christianity' (translated from the German of L. Feuerbach) (1854); 'Scenes of Clerical Life' (1857); 'Adam Bede' (1859); 'The Mill on the Floss' (1860); 'Silas Marner' (1861); 'Romola' (1863); 'Felix Holt' (1866); 'The Spanish Gypsy, a Poetic Drama' (1868); 'Middlemarch' (1871–72); 'Daniel Deronda' (1876); 'Impressions of Theophrastus Such' (essays, 1879).

George Eliot's 'Life', arranged and edited by her husband, John W. Cross, is chiefly an autobiography, composed of her letters and journals. This is the main source for succeeding biographers. Recent biographies: 'George Eliot and Her Times', by Elizabeth Haldane; 'The Life of George Eliot', by Emilie and Georges Romieu (translated from the French by Brian W. Downs); 'George Eliot, a Biography', by Blanche Colton Williams.

The GLORIOUS REIGN *of* GOOD QUEEN BESS

ELIZABETH, QUEEN OF ENGLAND (1533–1603). The long reign (1558 to 1603) of the "Virgin Queen" proved to be one of the most important in the annals of English history. When she came to the throne at 25, England was almost bankrupt and was torn by religious strife. It was weak and despised by the other powers of Europe. Many patriotic Englishmen believed that only a man, and a man of exceptional ability and courage, could raise the nation from its position as a second-rate power and bring peace. But Elizabeth successfully defied both France and Spain, and so skilfully managed affairs at home, that by the end of her reign England had grown powerful and prosperous, and was enjoying the greatest burst of literary activity the country has ever known.

Elizabeth was the daughter of Henry VIII and Anne Boleyn. Henry grew tired of Anne and had her executed before Elizabeth was three years old. Elizabeth was banished from court and little is known about her childhood until 1544, when an act of parliament recognized her as an heir to the throne next in line after her half-brother Edward and her half-sister Mary.

While Mary was queen, Elizabeth was pushed into the background. In 1554, Mary charged Elizabeth, who was then 21 years old, with conspiring against her, and jailed her in the Tower. Elizabeth was released two months later, but banished to Woodstock, one of the royal manors. Even when she was allowed to return to London, she was surrounded by spies and guards and was rarely permitted at court. At the death of Mary in 1558, Elizabeth was summoned to the throne amid popular rejoicing.

The Young Queen's Remarkable Personality

Her hard and dangerous girlhood had taught Elizabeth to be cautious in word and deed and suspicious of all. Her naturally good mind had been carefully developed by excellent tutors. She knew Greek and Latin and could talk with diplomats from France and Italy in their own tongues. Her health was excellent and her zest for life insatiable. She loved hunting,

dancing, plays and pageants. She was quick, witty, and often coarse in speech, loving a resounding oath as well as did her father, bluff King Hal. When she was amused, she would laugh loudly and long. When in a rage, she would spit on her courtiers or box their ears. Vain of her good looks, she was fond of extravagant dress, such as the cloak in the portrait on this page. At her death, she is said to have had 3,000 gowns in her wardrobe. In person, she was tall and gracefully built, with an olive complexion, keen eyes and a mass of auburn hair.

Elizabeth's first step as queen was to restore the reformed church practically as it had been under Henry VIII and Edward VI. For the next 30 years, aided by well-chosen counselors, she struggled to maintain England's independence from foreign control, and a compromise religious settlement. While everybody was compelled to attend the services of her "Established Church" or pay a fine, Elizabeth made it as easy as possible for both moderate Catholics and Protestants to attend her church without offending their consciences. She thus succeeded in winning the support of the majority of her subjects.

Yet a large Catholic party in England was plotting to put Mary Queen of Scots, whom they regarded as the rightful queen, on the throne in place of Elizabeth. They sought for their plots the aid of the pope, of the new and vigorous religious order of the Jesuits, and of the Catholic countries France and Spain. Elizabeth strove to hinder these plans by elaborately pretending that she was going to marry either the king of Spain or some French prince. To make trouble for her enemies, she aided the Protestant Netherlands when they revolted from Spain, and also helped the Scots when they went over to the Protestant cause.

QUEEN ELIZABETH AT FORTY

Elizabeth was a striking figure. Her face, a contemporary wrote, "is comely rather than handsome, but she is tall and well-formed, with a good skin, although swarthy; she has fine eyes, and above all a beautiful hand of which she makes a display." Everyone at court shared her love of elaborate dress and tried to achieve a long-waisted effect in imitation of her tall, graceful figure. In this "Rainbow portrait" by the Italian painter Zuccaro, she is wearing a cloak embroidered with eyes and ears, symbols of her wisdom. In her right hand, she holds a rainbow below the Latin inscription "Non sine sole iris," which means "No rainbow without a sun."

As a result of this change in Scotland, Mary Queen of Scots was compelled to flee across the English border where she fell into the hands of Elizabeth's officials (1568). Elizabeth's advisers urged her to have her rival executed as the indispensable means to her own safety. Not until 20 years had passed, and the King of Spain was gathering a great fleet to invade England, did Elizabeth yield to this advice and sign the death warrant of the Scottish queen on the ground of a plot against Elizabeth's life.

Now took place the most glorious event in Elizabeth's reign, the defeat of the Spanish Armada (1588). All England gathered itself to meet the foe. Elizabeth showed the courage of her race, when, clad in armor, she made a ringing and patriotic speech to her troops. Yet the credit for saving England belongs largely to others. She was the last to believe that the Armada was coming, and was so penurious in fitting out and provisioning the English navy as to risk defeat and prevent the victory from being as complete as it might have been. The real credit for the Armada's defeat is due to the skill and courage of the great English captains of the time and the generous gifts of English merchants. (*See* Armada, Spanish.)

But by this glorious victory England freed herself from the fear of a Catholic reaction and entered upon her great career of sea power and colonization. The Englishmen of that day felt a glorious new sense of

power which found expression in the writings of a group of brilliant men whose works have shed undying glory on the reign of Elizabeth. Supreme among these shone the immortal Shakespeare. It is in his verses that the new pride and love for England is most beautifully expressed—

This royal throne of kings, this sceptered isle,
This earth of majesty, this seat of Mars,
This other Eden, demi-paradise,
This fortress built by Nature for herself
Against infection and the hand of war,
This happy breed of men, this little world,
This precious stone set in the silver sea, . . .
This blessed plot, this earth, this realm, this England.

Elizabeth's Affairs of the Heart

Though Elizabeth never married, her suitors were numerous and she kept them dancing attendance until she was an old woman. Perhaps her heart was most deeply touched by Robert Dudley, Earl of Leicester, master of the horse, handsome and clever, husband of the ill-fated Amy Robsart. Her next favorite was the equally ill-fated Earl of Essex, whom Elizabeth alternately loved and scolded, seeming to care for him much as a mother cares for a spoiled child. Yet when he was condemned for armed rebellion Elizabeth forced herself to sign his death warrant. Motives of state policy, the dislike of her imperious nature to give herself a master, and perhaps a certain coldness of temperament account for her refusal to heed the wishes of her people to take a husband. It is to be noted to her credit that she did not permit her personal favorites to influence her action in matters of state, but consistently followed the advice of chosen and sagacious ministers.

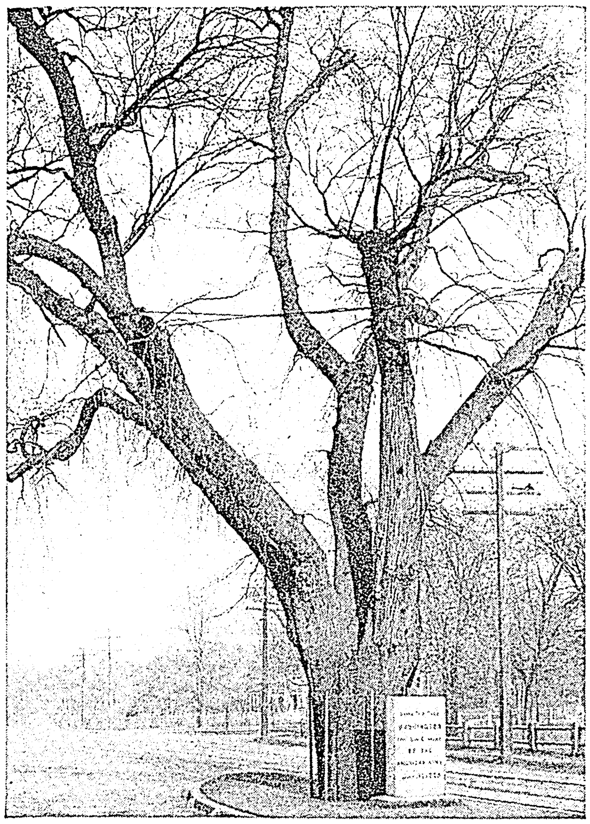
The religious question, the defeat of the Armada, and the flourishing of literature are the things we think of chiefly as marking the reign of the great Elizabeth. Not less memorable, however, are the hundreds of important laws—on shipping and commerce, roads and industry, poor relief and agriculture—which shaped the policy of England for more than two centuries after she and her statesmen advisers were in their graves. In fact, the reign of Elizabeth marked the passing of the main features of the Middle Ages, and the birth of modern England.

Elizabeth's vanity, her fondness for dress, her love of flattery and attention often made her appear ridiculous in her old age, yet she was ruler of England to the last. Not the least of her achievements was the fact that at her death in 1603 she aided the peaceful accession of her relative, the Scottish king, the Protestant son of Mary Queen of Scots, who became James I of England, and so brought about the permanent union of England with Scotland.

ELK. The largest existing representative of the deer family; in America the true elk is called the moose. The name "elk" is erroneously given in the United States to the "wapiti," a member of the red deer group which once numbered millions but has been reduced to about 40,000, found chiefly in the Yellowstone National Park region. (*See* Moose; Wapiti.)

ELM. The American or white elm is a tree dear to all familiar with New England, and is famous in American history. Every schoolboy has read of the "Washington elm" at Cambridge, under which Washington stood when he took command of the American army, and of the elm under which William Penn made treaty with the Indians. The American elm is a magnificent tree, sometimes towering to 125 feet, its height and its great arching limbs presenting a most stately and graceful appearance. In many New England towns the long arms reach quite across the wide roadways. Such elms are veritably of a race of giants, many specimens being known with trunks exceeding six feet in diameter. The range of the species is from Newfoundland to Florida and westward to the Rocky

THE "WASHINGTON ELM"



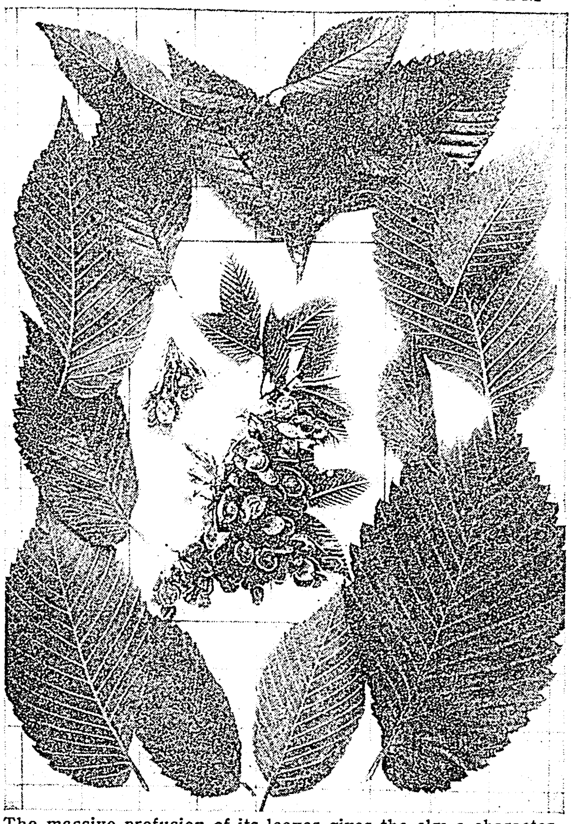
It was under this interesting specimen of its family that George Washington is said to have assumed command of the new Continental Army on July 3, 1775, while the colonists were besieging Boston after the battle of Bunker Hill. The picture shows the tree as it appeared before its fall, in 1923.

Mountains. In recent years caterpillars of the gipsy and brown-tail moths, and certain tree diseases have done irreparable damage in spite of millions of dollars spent by the state and national governments in combatting them, and some of the finest of these once glorious trees have been destroyed.

The slippery elm, also called the moose or red elm, is another American species. Its inner bark has a

pleasant taste, becoming slippery or slimy when chewed, and was once supposed to have medicinal qualities. The tree grows to 60 or 70 feet in height and has a broad flat crown and spreading branches.

FLOWERS AND LEAVES OF THE ELM



The massive profusion of its leaves gives the elm a characteristic beauty and makes it a favorite shade tree (for pictures, *see* Trees). The rather small leaf has a "serrated" or saw-toothed edge. The flowers are small, usually greenish brown, and in most species appear before the leaves.

The rock elm—called in some places the cork or hickory elm—is found from Canada south to Tennessee and west to Nebraska. It is distinguished by the small corky ridges on its twigs. The winged elm, or wahoo, of the Southeastern states is a much smaller species, seldom growing higher than 50 feet. Found only from Mississippi and Arkansas west to Texas, the cedar elm—sometimes called the basket elm—blossoms in the autumn.

The English elm, which is native to western and southern Europe, resembles the American elm in size and shape. It is planted in the United States as a shade tree.

Elms are valuable timber trees. The wood is hard to split, has an unusual bending quality, and holds nails. Hence it is used in the manufacture of boxes, staves, crates, tools, wagon wheels, and furniture.

Scientific name of American elm, *Ulmus americana;* slippery elm, *Ulmus fulva;* rock elm, *Ulmus racemosa;* winged elm, *Ulmus alata;* cedar elm, *Ulmus crassifolia;* English elm, *Ulmus campestris.* Bark ashy gray, rough. Leaves alternate. Flowers inconspicuous, in drooping clusters. Fruit winged, flat, enclosing the nutlike seed.

EL PA'SO, TEX. Situated in the extreme western corner of Texas on the Rio Grande, El Paso is one of the main gateways from the United States to Mexico. It is near one of the two lowest passes through the Rocky Mountains in the Southwest, and hence a natural place for railroads to cross from east to west. Their arrival in 1881 marks the beginning of the city's rapid growth. It is now served by six railroads, including the National Railways of Mexico, and several air lines and federal highways.

El Paso is the largest city on the Mexican border. It has no rival in size or commercial importance within a radius of 450 miles. From the rich surrounding lands irrigated by Elephant Butte Dam come fruits and vegetables for canning and cotton for manufacture. Copper and lead ores from New Mexico, Arizona, Colorado, and northern Mexico are shipped here for smelting. Other industries are oil refining and meat packing.

Reminders of Old Mexico add charm to this international city, and Spanish is heard as commonly as English. Its altitude of 3,762 feet and its dry, warm climate draw thousands of visitors seeking health and recreation. The Texas College of Mines and Metallurgy, a branch of the University of Texas, brings many students. Fort Bliss, just to the northeast, is one of the nation's largest cavalry posts.

El Paso, Spanish for "the pass," is named for the break in the mountains above. Spanish explorers came here in the early decades of the 16th century. In 1659 the mission of Nuestra Señora de Guadalupe was established on the site of Juarez, Mexico, just across the Rio Grande. Other missions soon sprang up on both sides of the river, but it was not until 1827 that settlement was made within the present limits of El Paso. The city was incorporated in 1873. The commission form of government was adopted in 1907. Population (1940 census), 96,810.

EMANCIPATION PROCLAMATION. The most important proclamation ever issued in the United States was that issued by President Lincoln on Sept. 22, 1862, announcing to 3,000,000 slaves that, if their masters were still in rebellion on the coming New Year's Day, they should be free from that date on. The abolitionists had long been urging Lincoln to take this step and had severely criticized him for refusing to do so; but Lincoln had replied, "My paramount object is to save the Union, and not either to save or destroy slavery." If he had decreed emancipation at the beginning of the war, Missouri and Kentucky, and probably Maryland, would have joined the South. After the war had been in progress for over a year there was no danger of this. On the other hand, if the slaves continued to produce food for the Southern armies, there was danger of the North being defeated. Lincoln had accordingly drawn up an emancipation proclamation in July 1862, and laid it before his cabinet. All but one of the members agreed with his policy. Seward approved, but urged that the proclamation should not be issued at that time, for the Northern armies were being defeated and it would seem that the North was appealing to the slaves for aid instead of aiding them. Lincoln agreed to the postponement, but vowed that as soon as the Con-

federate troops were driven out of Maryland he would issue the proclamation. The occasion came with the victory of Antietam, on September 17, and a preliminary proclamation was issued on September 22. The slaveholders paid no attention to its warning, and so on Jan. 1, 1863, Lincoln issued the final proclamation.

And from that rich and sunny land
The song of grateful millions rise,
Like that of Israel's ransomed band
Beneath Arabia's skies.—*Whittier.*

The final proclamation did not apply to the border states which were not in rebellion, and it could not be enforced in the regions held by the Confederate troops. But as soon as the Northern armies captured a region, the slaves there were given their freedom. The remaining slaves in the United States were freed by the 13th amendment to the Constitution (ratified Dec. 18, 1865), which decreed that "neither slavery nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist within the United States, or any place subject to their jurisdiction."

EMBARGO ACTS. The most famous historical case of embargo in the United States occurred in 1807–1808. England and France were engaged in a long and desperate war, growing out of the French Revolution and the ambitions of Napoleon. England interfered with neutral vessels going to ports controlled by the French, and Napoleon ordered that ships which obeyed the English orders should be seized. American commerce suffered severely. Hoping to bring one or both countries to consider the rights of neutrals, Congress passed a Non-Importation Act in 1806, forbidding the entrance of English goods, but it proved ineffective. Then upon the recommendation of President Jefferson an Embargo Act was enacted (Dec. 21, 1807) forbidding American vessels from putting to sea, in the hope that lack of American products would bring the other nations to terms.

The embargo made little impression on England and France, but almost ruined American commerce. In port towns, "not a box, not a cask, not a barrel, not a bale was to be seen on the wharves, where grass had begun to grow luxuriantly," and New England talked of seceding from the Union. Although the embargo was repealed, its ill effects were long in disappearing. It did not even save the United States from the necessity of protecting its rights by force of arms in the War of 1812 (*see* War of 1812).

In the American Embargo Act of 1807, the term *embargo* meant a prohibition by law upon the export of goods. During the World War of 1914–18 belligerent nations and many neutrals placed such embargoes on war materials. The term was also loosely applied to Great Britain's policy, in the World War and in the war that began in September 1939, of attempting to prevent neutral nations from transshipping goods to and from Germany. In 1935 the United States Congress prohibited the export in wartime of "arms, munitions, and implements of war" for use by belligerents. In November 1939 Congress repealed this "arms embargo." (*See also* Blockade; International Law; Neutrality Policy of the United States.)

EMBOSSING. Figures produced upon metal, leather, paper, textiles, cardboard, wood, and similar materials, when raised above the surrounding surface, are the products of embossing. It is one of the oldest of the arts, and beautiful examples have come down from very early times. It is widely used on leather and cloth in the making of fine bookbindings. Coins are made by dies that compress the metal and leave the raised design.

Figures that are raised on thin materials, principally sheet metals, brass, silver, and gold, may be hammered from the reverse side. This process called *repoussé*, a French word meaning "beaten back," was known to craftsmen of the ancient world. Repoussé is chiefly a hand process, but it is now often done by machines. Two dies are used: one has the figure inset, and the other, or counter-die, with the figure raised, forces the metal into the inset die.

Another process in which the design is pressed into the material is called *chasing*. This is often done on metal and leather work. Pressed metal containers, such as tea or coffee pots, or ice pitchers, are embossed by placing them inside metal counter-dies that have the figures inset. The object to be embossed is filled with water under great pressure, and the water transmits the pressure to the metal, forcing it into the design in the counter-die.

Embossing in needlework is done by making many stitches over a pad of felt, wool, or other material cut in the desired shape. Sometimes figures are pressed into wood; when the wood is planed and then soaked in water, the depressed parts swell above the surrounding surface. Metal cut by dies in the industrial arts is also said to be embossed.

EMBROIDERY. One of the most common forms of decorative needlework, found in almost every home, is called embroidery. Linens and women's and children's garments often show examples of this art. (*See* Textiles and Embroideries.)

EMBRYOLOGY. The building of an animal's body is the most wonderful thing in all nature. An insect, a fish, or a bird begins its development as an egg, and, as the construction of the body goes on, each tissue and each organ is formed anew out of the materials contained within the egg.

After three weeks' incubation of the hen's egg, for example, the young chick steps into the world with heart, brain, eyes, and other organs all formed—a remarkable transformation. Frogs' eggs, laid in the water, undergo similar changes without any care from the parent; tadpoles hatch from them, and in due course of time these tadpoles grow into frogs, with a different kind of body.

The hen's egg is large, because there is a large quantity of food-yolk stored up for the use of the growing chick; the frog's egg is smaller, because it contains less yolk; and some eggs—for example, those of starfishes—are smaller than pin-heads.

The true starting point of the chick is a tiny cell within the egg—so small it can be seen only under a microscope; and when we look to other animals we find that all of them, no matter how complex, start from a similar tiny cell. Between that simple state and the fully formed animal there are many steps. Therefore the adult stage of any animal represents the last step in a long series of changes.

If we could only follow these, step by step, we should understand all about the construction of animals and their past history. Tracing the stages by which cells emerge into tissues, tissues into organs, and how the organs by combination build the body is called embryology.

It is an important fact to keep before us that the rudiment of all life is a cell (*see* Cell). If we look upon cells as the bricks of organic architecture, the starting point of a many-celled animal is a single brick; but, inasmuch as each egg needs to be fertilized before developing—just as a plant-ovule must be fertilized by pollen before it becomes a seed—the single brick is a compound one, made of material derived from each parent.

The development of all animals is remarkably alike. From the single cell there come, by division, many cells; these continue to feed on the yolk, to grow and divide; and thereby a large number of cells arises. These cells arrange themselves into definite layers, and it is from these layers that all parts of the body are formed.

It took over a half-century after Harvey and Wolff in the first half of the 18th century for this view of cell development to replace the earlier view that the animal existed already formed within the egg, but was exceedingly minute, and that development consisted in the expansion or growth of this animal in miniature. Then K. E. von Baer (1792–1876), the father of modern embryology, showed that all the tissues and organs come from cell-layers or germ-layers. One layer gives rise to nerves, another to skin or feathers or fur, and a third splits and from it come the internal organs, bones, etc. This is the germ-layer theory.

Other scientists broke down the rigid line that was supposed to separate vertebrated and invertebrated animals (those with backbones and those without), and indicated how higher types had been developed from simpler ones. The chick, and for that matter man himself, in the embryo has gill clefts like a fish. These disappear but they give clues leading to the time when all were water-breathers and had use for gills. Thus embryology retraces life's history, contributing important evidence in support of the belief that the higher animals have been evolved gradually from the simpler ones. (*See* Evolution.)

The SAGE *of* CONCORD *and His* TEACHING

EMERSON, Ralph Waldo (1803–1882). No American writer had a more powerful influence on his generation than did Emerson, and none has better stood the test of time. His appeal is universal. Young and old, wise and simple, learned and untaught, turn to him again and again for refreshment. Some of the keenest and best minds in both the Old World and the New have accounted his message of resolute self-reliance as one of the cardinal factors that shaped their lives and thinking.

RALPH WALDO EMERSON
The Teacher of "Self-Reliance"

Emerson's ancestors were Puritans who came to New England in 1635. He sprang from eight generations of ministers. Emerson's father died when the boy was eight years of age, leaving the family poor. He went to Harvard in 1817 and, although elected class poet on graduation, he received no honors for scholarship. Even in those early days he preferred to seek his own mental food rather than to follow meekly the paths laid down by his teachers.

On leaving college, Emerson taught in his brother's school for awhile and then studied for the ministry. His preaching, however, was interfered with by poor health and he was forced to go South. On his return he accepted a Unitarian pastorate in Boston and was married to Miss Ellen Louisa Tucker.

Through all his early years Emerson had been a quiet unobtrusive self-contained person. He thought much, wrote a little, and said less. He was genial and kind in his attitude toward people around him, but he was always most difficult to know intimately. His early married life was happy; and for the first 30 years of his life he seemed destined to follow peacefully in the footsteps of his ministerial ancestry. But underneath the quiet exterior was a steadily growing resolve which was to separate him from the church. Emerson found that even in the simple ritual of the Unitarian service there was much to which he could not agree. He resigned his position as minister, greatly to his relief.

For a time he did not find himself. His young wife died in 1831 and Emerson's own health broke down again. He went to Europe, saw the wonders of the Mediterranean countries, and visited England. There he met most of the great men of letters of the day: Landor, Coleridge, John Stuart Mill, and above all, Carlyle, whom he admired more than any. But it is curious to see that travel and great men meant but little to Emerson. He said in his essay on 'Nature', published some years later: "The difference between landscape and landscape is small, but there is a great

difference in the beholder." As for the men, they seemed to him inferior in intellect, except Carlyle, with whom he corresponded for many years.

On Sept. 14, 1835, he married Miss Lydia Jackson. Prior to this time he purchased a house with a pretty garden attached, in Concord; and there, surrounded by his family, he passed the remainder of his life, save for the breaks occasioned by lecture engagements and two journeys to Europe. When his house was burned, in 1872, a nation-wide popular subscription was taken and the funds used to rebuild it. He died after a short illness on April 27, 1882, and was buried in Sleepy Hollow cemetery on the outskirts of Concord.

To understand Emerson's aloofness from men and events one must grasp his way of thinking. He believed that great truths come to us by intuition—that is, that they come to us unbidden. Furious striving avails us nothing; truth comes gently and unawares. Most modern philosophers do not agree with Emerson; they think that truth may be reasoned out. Besides, they are interested in the working out of truth in relation to human life, while Emerson was always on the alert for the first dawning. He never finishes but is always beginning, and his beginnings have been inspirations to the people of two continents.

EMERSON'S TRIBUTE TO BEAUTY

"Wherever snow falls, or water flows, or birds fly, wherever day and night meet in twilight, wherever the blue heaven is hung by clouds, or sown with stars, wherever are forms with transparent boundaries, wherever are outlets into celestial space, wherever is danger, and awe, and love, there is Beauty, plenteous as rain, shed for thee, and though thou shouldst walk the world over, thou shalt not be able to find a condition inopportune or ignoble."

How are men to arrive at truth? Emerson gives his answer in 'Self Reliance'. "To believe your own thought, to believe that what is true for you in your private heart is true for all men—that is genius. Speak your latent conviction and it shall be the universal sense; for always the inmost becomes the outmost—and our first thought is rendered back to us by the trumpets of the last judgment." "God is in every man." The last phrase is the keynote of what is called the "transcendental movement," or that faith in the "inner light" of which Emerson was the chief exponent.

When Emerson returned to America he had begun to lecture and to write freely. He edited *The Dial*, a paper which spoke truth fearlessly, for a few years. Harvard asked him to give several addresses, one of which, 'The American Scholar', was called by Oliver Wendell Holmes "our intellectual Declaration of Independence." His lecture tours carried him all over the country. In those days, one must remember, travel was a series of hardships and inconveniences. Emerson reached a large number of people, most of whom did not understand him at all.

There was something more than truth that drew the crowds. It holds us now when we read the essays in a quiet room; it holds the thoughtful young soldier on a crowded troopship. But in the early days people often came to scoff and remained to listen, much impressed. Emerson the man held them. He was a man of charm and vigor; he had a style which is almost unequaled. Oliver Wendell Holmes said: "No one who ever heard him speak will forget the play of his features, the lighting up of his eyes with a rapt inner illumination, the emphatic stamp of his foot when some weighty thought required enforcement." In the matter of style he stands supreme for his power of saying much in little, of so phrasing his thoughts that they sparkle and glow. Every sentence seems as good as the one it follows. This is true of his poetry as well as his prose—that is, the power of stating truth in sharp relief. His poems are among the greatest ever written in America.

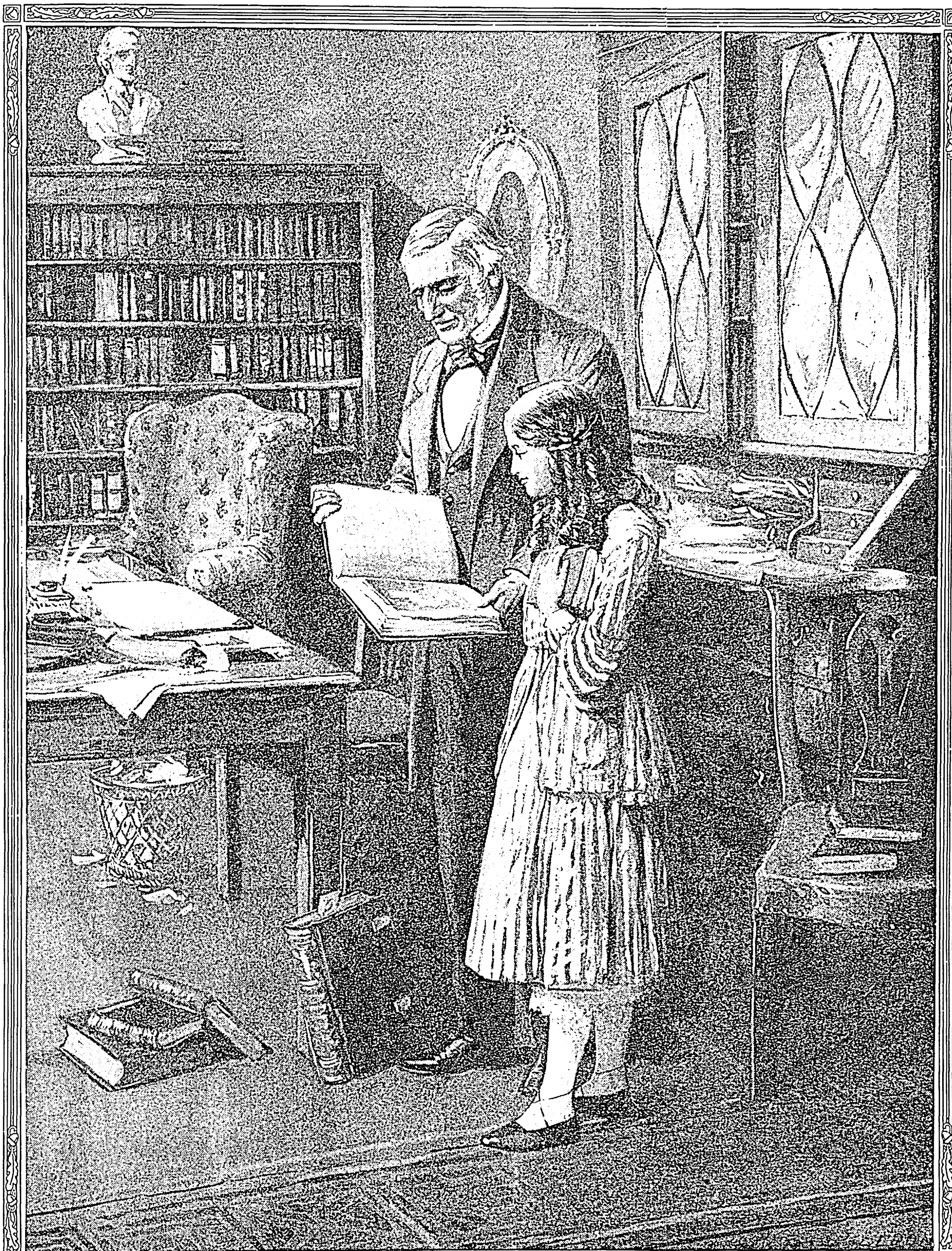
Emerson has been criticized for the lack of organization or plan in his essays. But we must remember that he never tried to put plan there. One might say that he was too honest. He said what he had to say, as it came to him, and considered himself as the mouthpiece. Emerson is still read—he is read more and more as the years go on, while many of his critics are forgotten.

Emerson's principal works are: 'Essays, First Series' (1841); 'Essays, Second Series' (1844); 'Poems' (1847, 1865); 'Representative Men' (1850); 'English Traits' (1856); 'The Conduct of Life' (1860); 'Society and Solitude' (1870).

EMERY. In outward appearance emery has nothing in common with the sapphire and other precious stones to which it is related. It is a dense, opaque, dull substance, like a fine-grained iron-ore, ranging in color from reddish-brown and gray to blue-black. It is found in large bowlder-like masses in Asia Minor and on Naxos and some of the other islands of the Grecian archipelago. Small amounts are found in the United States. The rock is made ready for use by breaking it into lumps and crushing these to powder in stamping-mills. It is then sifted to various degrees of fineness. As emery-powder is one of the hardest natural substances, it is used for cutting and polishing many kinds of stone. Glass stoppers are ground into their fittings with it. Plate glass is ground flat by its means. When used for polishing metals, it is spread on some kind of surface to form emery-paper, emery-cloth, or emery-sticks. Emery-wheels, used for grinding, are a mixture of emery-powder and some cementing substance.

Emery is an impure variety of the mineral *corundum*, which is chemically an oxide of aluminum. The beautifully colored crystalline varieties of corundum are known as sapphire, oriental ruby, oriental topaz, etc. Corundum in less beautifully colored forms is used like emery for grinding and polishing. Ontario is the chief source of supply.

THE PHILOSOPHER AND THE LITTLE GIRL AMONG THE BOOKS



Of course you know this is Ralph Waldo Emerson, and you can see that he is talking books with the young girl; but who do you suppose that girl is? She is Louisa May Alcott, author of "Little Women"! When she was a little girl, living there in Concord, she used to be a regular visitor at the home of the Emersons, and she spent many happy hours with the great man, who used to go about with her among the books and help her pick out the ones he thought she would like best and that it would do her the most good to read. The scene is typical of the many happy gatherings in Emerson's home, for it was a favorite meeting place for writers, philosophers, and other notable figures from all parts of the country.

EMOTION *and How It Helps* MEET EMERGENCIES

EMOTION. Every day, almost every hour, of our existence, we are influenced by emotion, in some of its great variety of forms. Since much of our happiness and success in life depends on our ability to control our emotions, it is important to understand how they work.

In the sense of "emotional shock," emotion may be defined as a state of conscious stir or excitement, arising from emergencies which have broken an organism's normal course of adjustment. Thus, we become angry when we are baffled in some activity, and we show fear when we are startled by a novel stimulus or by a threatening situation. In a more general sense, psychologists sometimes use the term emotion as referring to the feelings of pleasure or displeasure which pervade the background of our everyday experience.

Psychologists have made a careful study of emotion, beginning with the lower animals. The French psychologist, Dr. Pieron, gives this description of emotional behavior in an octopus:

> I lift a rock which has been left exposed by the ocean; I perceive an octopus, covered with little stones, motionless; I try to seize it, and the animal moves away hastily or, if I take hold of it, grasps my hand in its tentacles so as to bite me with its horny beak. . . . At the same time its chromatophores (color spots on the skin) are frantically displaying the continual changes of color, which pass over its skin like shivers, and its pupils become abnormally dilated.

A cat chased by a dog spits, arches its back, displays a bushy tail, unsheathes its claws and glares at the enemy through widened pupils. On the trail of a mouse, it displays a lithe eagerness and creeps toward its prey with tail swishing and muscles tense.

Emotion in human beings is much more complicated, but it is similar in many ways to emotion in animals. The hungry infant who throws himself about in his crib, the child in school who flushes and stammers, the football player who clenches his fist and suddenly attacks the referee—all these are under the influence of emotional states. All such emotions involve unusual excitement and give rise to actions which are more or less unplanned or irrational.

Outward and Inward Signs of Emotion

Everyone is familiar with the outward physical signs of emotion. The person in a sharp attack of anxiety breaks out into perspiration. The angry person reddens and then turns pale. The frightened child trembles. At the same time certain disturbances are taking place within the body. The blood pressure increases; the pulse beats faster; breathing is more rapid and disordered; the normal processes of digestion are halted; even the supply of blood has been directed away from the stomach and toward the trunk muscles and into the arms and legs. The adrenal or suprarenal glands, which sit like tiny cocked hats on top of each kidney, pour an increased supply of adrenal fluid into the blood. This speeds the heart beat, changes the chemical composition of the blood, diminishes the toxins caused by fatigue, and increases the speed with which blood clots when it is exposed to the air. (*See* Gland.)

We can easily see the usefulness of these reactions in certain situations. The changes in breathing, blood pressure, and pulse rate are of help to the man who faces sudden danger and must fight for his life or seek escape. The adrenal glands, working at high speed, prevent his feeling fatigue; and, if he should happen to be wounded, the prompter clotting of the blood helps the injury to heal. Emotion, then, may be regarded as Nature's way of equipping us to meet emergencies.

In calmer times, too, emotion plays its valuable part in enriching life. Our friendships, our enjoyment of music or poetry or trees or flowers are, in large measure, emotional. Our love of country, our loyalty to school or football team, have a strong emotional quality. The desire to achieve great things is closely related to emotion. During intense excitement we sometimes have "inspired strength" and can accomplish things we had not thought possible. Even the achievements of genius may be ascribed to the joint action of exceptional intelligence and an exceptionally intense and concentrated emotional drive.

How Emotions Help or Hinder Us

Thus we see that emotions serve useful ends in our lives. They have their unfortunate aspects too. We have seen that emotion aids the man who must fight or run for his life. However, in modern civilization, most problems cannot be met by fighting or running away but must be solved by calm reason. But thinking is hindered by emotional stress. It is doubly hard to reason calmly when we are stricken with fear. Again, each strong emotion seeks expression in physical activity, such as fighting when we are angry, and running when we are frightened. Denied these outlets, they may become physically harmful.

Emotions are sometimes organized into strange patterns called "complexes" which may cause great difficulty. A common type of complex is the "phobia" or abnormal fear, such as the fear of high places, open spaces (*agoraphobia*) or close rooms or tunnels (*claustrophobia*); or certain kinds of animals. It is said that a British general, otherwise brave, was so afraid of cats that he could not sit down in a room containing a harmless pussy. Emotions which have been allowed to drift into wrong channels may find expression in the form of temper tantrums, irritability, needless worry, or extreme shyness. Physicians of a certain school (the "psychoanalysts") believe that many forms of mental disturbance are due to repressed emotional complexes.

Such facts show the importance of learning emotional control. This does not mean the repression of all emotion but simply the forming of habits and attitudes which will make the best use of our emotional tendencies. Some principles in training the emotions are considered in the article Mental Hygiene.

EMPLOYERS' LIABILITY. According to the "common law" in England and America, a workman when taking employment agrees to assume all the ordinary "risks of industry," including not only those resulting from his own negligence but those due to the carelessness of his fellow workers. With the increasing use of machinery and steam power, accidents in industry became very common, and in the large establishments vast numbers of men were considered "fellow servants" in the eyes of the law, making the recovery of damages impossible in the great majority of cases. An Employers' Liability Act was therefore passed by the British Parliament, in 1880, which defined and enlarged the employer's liability and gave compensation, whether or not the accident was due to the negligence of fellow workers. Similar acts were later passed in most of the states of the United States.

Under such laws, the injured workman either had to bring suit or accept what the employer offered. This process was slow, expensive, and unsatisfactory to both workmen and employers. Hence the employers' liability system has been almost entirely replaced by workmen's compensation laws. Nearly all the states have such laws, providing definite rates and terms for compensation. Federal laws apply to the District of Columbia and to all United States civil employees.

The extension of employers' liability has resulted in the growth of "employers' liability insurance," by companies which undertake, in return for a premium paid by the employer, to pay any damages to workmen for which the employer may become liable. Recent laws in some states make such insurance compulsory. The result of these laws is to force employers to use safer machinery and better working conditions, and otherwise remove many just grievances of employees.

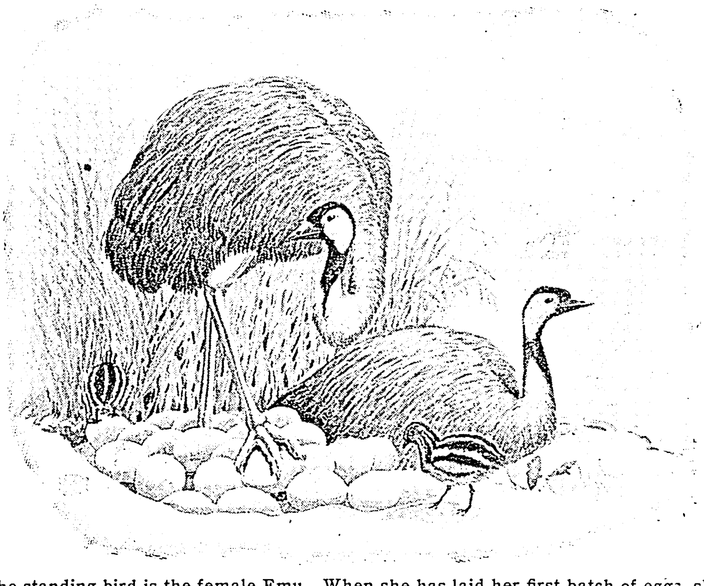
EMU (*ē'mū*). Closely related to the cassowary, this running bird of Australia lives on the plains, as the cassowary does in the forest and dense scrub. The emus, however, have no cap or helmet such as the cassowaries wear. Also the head and neck are not bare as in the cassowaries, but are provided with feathers. The plumage is heavy and dull brown in color; it has no ornamental value. The wing-rudiments are very small. The bird stands about five feet high, ranking next to the ostrich in size. Its food is exclusively vegetable, consisting of fruits, roots, and herbage. It may be tamed, and breeds easily in captivity. It lays 9 to 13 dark green or bluish eggs, nearly as large as ostrich eggs, in a cavity scooped in the earth, usually in sandy soil. Male and female assist in hatching them. Scientific name, *Dromaeus novaehollandiae.*

ENAMELING. The marvelously delicate pieces of "cloisonné" ware in the jeweler's window, the exquisite glazed decoration of cups, plates, and vases carefully preserved in museums, many of the pretty vanity cases women carry, the bright white equipment of bathrooms, graniteware, and the shining blue and white kitchenware that never rusts, are all examples of enameling. Enameling means coating a base of metal, pottery, or other mineral substance with finely powdered glass and then heating it until the particles melt together and form a glaze.

Enameling as an art has a long history. The ancient Egyptians and Assyrians used enameled bricks of wonderful luster in the walls of their palaces. They also used enamel in the decoration of jewelry. The Greeks and Romans were masters of the art, employing it both in jewelry and as an accessory of sculpture. In Ireland and England numerous ancient enamel ornaments have been dug up, including jewels, pins, harness plates, etc., of many different colors. Ancient shields and helmets were studded with enamel colored to resemble coral and precious stones. Many old crowns have enamel ornamentations. Evidences are many that the art early existed also in Persia, Asia Minor, southern Russia, China, Japan, and India. Today the Japanese are especially famous for enamel work.

One of the most beautiful of enamel wares is the cloisonné ware, mentioned above. Thin metal strips are soldered to a basis (usually of the same metal) to form a design. The little cells thus outlined are then filled with enamel pastes of various colors—bright hues for flowers, green for leaves and branches, black for shadows. The piece is then baked or

HATCHING THE EGGS IN BATCHES



The standing bird is the female Emu. When she has laid her first batch of eggs, she leaves them for her mate to sit upon and hatch, as he is doing in this picture. Later she lays a second batch, and sits upon them herself, while the male Emu tends the striped chicks already hatched.

"fired" several times until the enamel has been built up to a sufficient height. When the last firing is safely over, there follow weeks of polishing with

A SPLENDID EXAMPLE OF CHINESE ENAMEL

This figure of Kwan-Yin, which now belongs to the Victoria and Albert Museum in London, shows the mastery possessed by the Chinese artists of enameling over porcelain. The perfection of the workmanship and the artistry of the finished product are remarkable.

pumice stone under running water. During this process the rough surfaces become smooth and shining, until the finished work appears a thing of marvelous beauty in color and design.

Another form of inlaid enamel is *champlevé*, which is made by cutting grooves in the metal itself—usually bronze or some other metal less precious than gold—to form the design, and filling these grooves with the enamel. A considerable portion of the metal is usually left as a background for the enamel design Many of the valuable old Chinese enamels are champlevé.

In the later Middle Ages artists began to make painted enamels. In this form a coat of enamel is fused over a metal surface, and a design is painted on this background with enamels of various colors. Numerous firings are necessary before the work is completed. Many beautiful plates, bowls, pitchers, salt-cellars, candlesticks, and fine enamel miniatures are to be seen in museums and private collections; and some gorgeous translucent enamel windows have been placed in great cathedrals. Perhaps the finest examples of painted enamels are those produced at Limoges, France, which are distinguished for their elaborate detail.

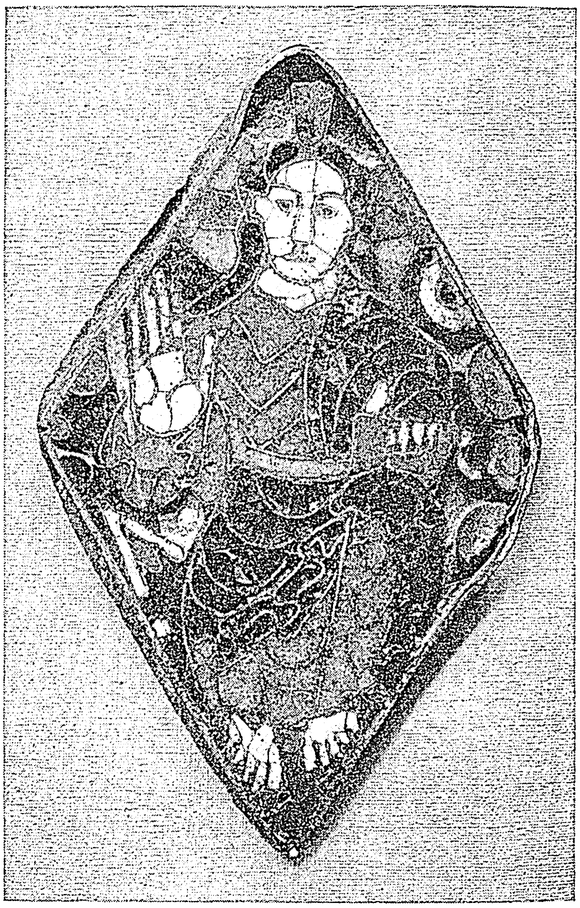
In recent decades the art of enameling has undergone a marked revival. New processes have been invented which produce enamels of a much greater variety of colors than were formerly known, and superior in brilliance and durability.

The most important industrial use of enamel is giving iron and steel utensils shining coats of opaque glass. In the United States alone there are hundreds of factories devoted to producing enameled ware.

Into the making of enamels go many substances—feldspar, quartz, fluorspar, borax, boric acid, soda, potash, saltpeter, clays, ammonium carbonate, stannic acid, and water. Many coloring agents are employed. If the ware is an intense blue, it is probable that cobalt oxide was used to color it; the soft grays which are so popular are generally made with nickel oxide.

Each manufacturer guards the secret of his ingredients with many precautions. The chemicals are

AN ANCIENT PIECE OF CLOISONNÉ



This ancient plaque shows clearly how cloisonné enameling is made. Metal ridges are set up, and enamel is applied in patches between the ribs. In later work, such as the Japanese vase on the next page, the ridges are almost too fine to be seen.

WHAT TRUE ARTISTS CAN DO WITH ENAMEL

The three specimens of enamel ware above show the many possibilities for varieties of beauty which may be obtained by this process —pictures, complex lines and figures, and ornamented flat surfaces. The platter is a beautiful treatment of 'The Last Supper', done in painted enamel on a copper base, by the French artist Jean Reymond in the second half of the 16th century. The jar is a modern specimen of Japanese cloisonné work, while the wine pot with the handle is of enameled copper. The dish and the wine pot are in the South Kensington Museum, London, and the jar in the Metropolitan Museum of Art in New York.

kept in separate bins and are always spoken of by number, never by name. The weighing is done on scales so adjusted that only the person in charge of the work can see them.

After the ingredients are carefully mixed, the "melt" is made in a blast furnace. When the heat has changed them into shining molten glass, a plug is drawn and the vitreous liquid falls hissing into a tank of cold water. With explosive violence the whole mass is torn into shreds, and even the shreds are cracked into innumerable fissures. This "quenching" toughens the enamel body and makes easier the grinding, which is the next process. During the grinding, coloring matter and other ingredients are added.

When the whole mass has been reduced to a very fine powder, it is mixed with water and a little ball clay, and then it is ready to apply. The operator dips the cleaned metal vessel into the liquid enamel or "frit" as it is called, covering every part, and then places it on three metal points to dry before it is taken to the furnace room, where it is fired. From two to four coats are usually applied. "Agateware" and "graniteware" are trade names for varieties of enameled ware.

ENERGY. Did you ever hear of a "perpetual motion machine?" Perhaps not under that name, but such machines are still proposed in more or less complicated forms. A perpetual motion machine is a device which is supposed to run itself without fuel or other outside aid, and yet is able to do work. Thousands of machines of this kind have been proposed by ingenious inventors. One of the simplest is a water-wheel run by water from a pump, the pump itself being driven by the water-wheel; and in addition to the wheel running itself, the inventors of this machine planned to put a pulley and belt on the axle to run a mill.

No such device has ever worked, although thousands of gifted mechanics have wasted their lives trying to develop such machines. Further, science tells us that no such machine ever will work. Why is this so? It is because nature seems to have placed a certain amount of energy in the universe, and ruled that none of this energy can ever be lost, nor can it be increased. We can merely *transform* energy from one kind to another.

The railway locomotive shows how the principle works out. First the engine uses coal, which is stored up energy, and turns it into heat energy by burning. The heat energy turns the water in the boiler into steam, a form of expansive energy. The engine turns this expansive energy into mechanical energy, which runs the engine. From beginning to end, the chain is unbroken. We have transformed one kind of energy into another; but at no time have we created any energy.

Neither, for that matter, have we lost energy. We didn't get all the heat energy of the coal in the form of steam. But the missing energy wasn't destroyed. Some of it warmed the air around the boiler; some went up the smokestack. It wasn't destroyed; it merely went where we didn't want it. So too with the energy lost by friction in the engine.

The statement that energy cannot be created or destroyed, but is merely transformed, is called the *law of conservation of energy.*

This example shows another important fact about energy. The whole chain started with coal, which is inert until we set fire to it. It was what science calls *potential* energy—energy ready to work but not yet working. When we burned the coal, we turned its potential energy into heat—that is, into *kinetic*, or *active*, energy. We can reverse the process, if we wish, though not with coal. We can pump water into an elevated tank. Being there, it has potential energy, for it can do work whenever we let it down; and we used the kinetic energy of the pump to accomplish this.

The Sources of Energy

What then can the engineer do with energy? All the engineer can do is to devise machines for transforming energy. He cannot make a machine to create energy. And his greatest task is to study nature's sources of energy or stored-up work, so that he can transform this into useful work.

What are these sources? Only two or three sources have large value for the industries. These are: the chemical energy of coal and coal oil (petroleum) and, to a less extent, of wood; the energy of water-power of the rivers and streams; the energy of the winds which drive windmills, sailing ships, etc. There are others, but we have not learned to use them much.

All these sources, however, may be reduced to one. Coal, water-power, and wind, all may be traced back to that great life-giver, the sun. Heat from the sun draws water up into clouds, so that it may fall, run seaward in rivers, and be harnessed for power. The sun likewise heats portions of the earth irregularly, thereby causing winds. Sunlight, absorbed by green leaves, makes plants possible; and plants, besides furnishing our coal, support all human and animal life. So all living energy traces through plants to the sun.

Having traced all these sources of energy to the sun, we may ask how the sun gets its energy. Some may come from meteors falling into the sun; and some from the sun's contraction. But science now believes that the greatest source of energy is the action of atoms and electrons within the sun.

Atoms and electrons give off energy by sending radiations through space, just as the end of a stick whirled rapidly in still water will send disturbances radiating over the surface. This process works the other way around too. If you sent water waves against particles such as bits of cork, it would set them moving. So likewise heat, light, and other waves sent against electrons set them going faster. That is, the electrons *absorb* energy, which they give

off in turn as light or heat, or perhaps as chemical action. (*See* Radiation.)

Now comes a remarkable fact, only recently discovered. If you were transforming energy by heating iron until it gave off light, you might think that the more you heated it, the more light it would give. This is not exactly true. Fine measurements show that after it is glowing, the iron will absorb a certain amount of heat without giving off more light; then just a trifle more heat will make it give off considerably more light. It seems as though it has to absorb a definite quantity of energy before it can change at all; then it changes all at once and emits the entire amount absorbed.

Scientists have measured this mysterious "unit quantity" of energy, called a *quantum*, and are discovering why matter behaves this way. They think that electrons do not absorb or give off energy while merely moving in their orbits, but only when they *jump* from one orbit to another, jumping to outer orbits when they absorb energy, and falling inward when they emit energy. The "quantum" is the amount needed to make one electron jump from one orbit to the next, or given off when it falls inward one orbit. (*See* Atoms and Electrons; Physics.)

This wonderful story of the forces of nature and the transformation and conservation of energy was worked out about 1840 by Joule, Helmholtz, Kelvin, and other men of that time. The quantum theory has been added by Planck, Bohr, Einstein, and others, commencing about 1900.

ENGINEERING. The skilled engineer of today is not only a builder; he is an expert who can solve the most intricate economic and financial problems, and can forecast the future. Thus, an engineer locating a railway line can tell what route will yield the largest earnings, through his knowledge of the effect of grade and curvature on the cost of haulage and other such details. Before the United States started work on the Panama Canal—the greatest engineering achievement in history—engineers estimated that the cost of digging 100,000,000 cubic yards of rock from the Culebra cut would be 80 cents a yard. When the canal was completed some 15 years later, it was found that they had overestimated by less than two cents a yard!

The increasing complexity of industry makes the expert engineer more and more a necessary factor, not only in industry, but in governmental supervision of industry. The United States Interstate Commerce Commission employed hundreds of engineers to value the country's railways. State public utilities commissions often employ scores of engineers. Enormous projects requiring the services of big engineering staffs for five or ten years are sometimes necessary to supply a great city with water.

The present tendency is for industrial engineering to concentrate in the hands of large firms employing many engineers. Probably 95 per cent of American engineers work on a salary, either for commercial firms, or in city, state, or federal service. In the work of the engineer is included the design and planning of the engineering project, and the supervision of the carrying out of the work. In some cases the engineers contract for the construction of the work. An engineer who gives advice as an expert on engineering work is termed a "consulting engineer." As a consulting engineer is frequently asked to advise on the work of other engineers, he is generally a man who has had considerable experience in his field.

There are four principal divisions of engineering: civil, electrical, mechanical, and mining engineering. "Civil engineering" comprises works in connection with transportation, such as railways, canals, and roads; works which have to do with water, such as public water supply, irrigation, drainage, and sewerage; works of river and harbor improvement; and structural works, such as bridges, buildings, dams, piers, docks, etc. "Electrical engineering" deals with the design, construction, and application of electrical machinery and apparatus. "Mechanical engineering" is the art of machinery design and construction. Mechanical engineering so far underlies engineering of every class, and all kinds of industrial operations, that it can almost be said to sustain the whole fabric of modern civilization. "Mining engineering" includes the work in connection with the exploration for mines and their development. The highest professional skill is required to examine and report on the value of a mine and its probable life.

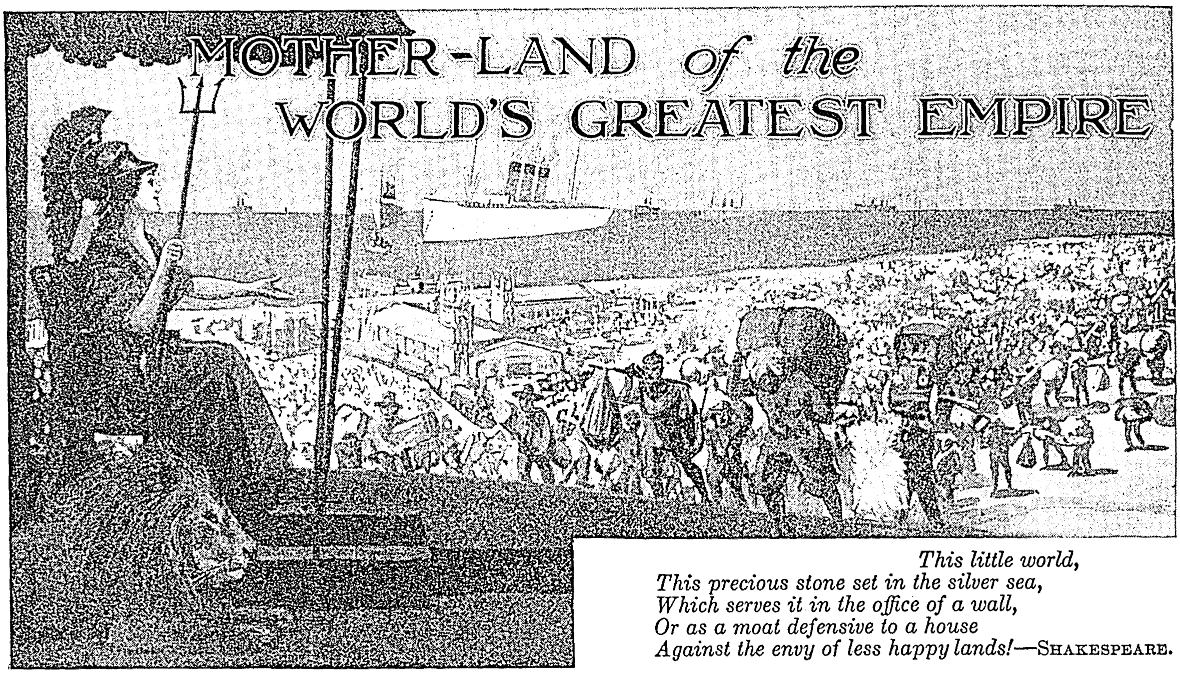
Each of these divisions includes a large and increasing number of specialized lines, totaling 100 or more. Thus, civil engineering includes railway, hydraulic, structural, sanitary engineering, etc. Mechanical engineering includes steam, gas, automobile, heating and ventilating engineering, etc. Many distinguished engineers, however, do not specialize at all, but act as technical executives, directing the work of various engineers to complete a great construction work or conduct a huge manufacturing or mining industry.

Other important branches are military engineering and marine engineering. "Marine engineering" embraces the building and operating of ships and naval accessories, the construction and planting of torpedoes and mines, etc. "Military engineering" includes the construction of fortifications, trenches, military bridges, pontoons, army telegraph and telephone systems, etc. The United States army and most of the other armies of the world maintain a special engineer corps (*see* Army).

Among the most notable engineering works of remote antiquity are the Pyramids of Egypt (*see* Architecture; Pyramids). The Hanging Gardens of Babylon were one of the wonders of the world; and the harbors and temples of ancient Greece testify to no little engineering skill. The theaters, temples, baths, aqueducts, roads, bridges, and drainage works of ancient Rome vie in extent and magnificence with many celebrated modern works. Other engineering

feats of former days are the Dutch canals and embankments for inland navigation and for protecting the low lands from the sea, and the cathedrals and castles of medieval Europe.

Notwithstanding the large number of students of engineering in our colleges, the demand for technically trained men is so large and so varied and so many new fields of technical work are being opened, that few engineers of worth fail to find profitable employment. For a youth fond of mechanical and construction work and with a taste for mathematics and physics, engineering offers a fine field for attainment and service to mankind. Energy, sound practical judgment, and a painstaking accurate temperament are essential. For the degree of C.E. (Civil Engineer) or M.E. (Mechanical Engineer) most technical and engineering schools of repute require four years of undergraduate work, about three years of successful experience and one year of graduate work. One can scarcely hope to be trusted with important engineering works before he is a man of maturity, with years of technical study and practical experience.



This little world,
This precious stone set in the silver sea,
Which serves it in the office of a wall,
Or as a moat defensive to a house
Against the envy of less happy lands!—SHAKESPEARE.

ENGLAND. In the latitude of Labrador, off the Atlantic coast of Europe, lie the British Isles, of which the largest—Great Britain—is divided into Scotland, England, and Wales. England, the chief of these divisions, forms a triangle whose greatest side is only 425 miles. Along the western side of the island are low mountains, especially in Wales; and in northern Scotland the mountains are quite rugged. But the Cheviot Hills, which separate England from Scotland, and the Pennine Range, which runs southward into England and is called its "backbone," seldom rise above 2,500 feet. In the southwest, the Mendip Hills (highest 1,067 feet), the Cotswold (1,100 feet), and Dartmoor (2,039 feet), though containing tracts of wild and desolate country, can nowhere be considered mountainous.

Extent.—North to south, 354 miles; east to west, 210 miles; coast line more than 2,000 miles. Area, 50,874 square miles. Population 37,800,000.
Natural Features.—Low rolling country, broken by the Pennine Range in the north (highest point, Sca Fell, 3,210 feet), and the Downs and Devon hills in the south and southwest; Cambrian Mountains in Wales (highest point, Snowdon, 3,560 feet). Principal rivers: Tyne; Humber (Trent, Derwent, Swale, Wharfe, Aire, and Don); Welland, Nen, and Great Ouse; Thames; Avon; Severn and Wye; Mersey. Climate, mild with little variation.
Products.—Wheat, barley, oats, hay and forage crops, fruit, potatoes; cattle, sheep, hogs, horses, dairy products; herring, haddock, cod, and other fish; coal, iron, and clay; textiles, iron and steel manufactures (including cutlery and machinery), clothing, pottery, ships and boats.
Cities.—London (population of "Greater London" 8,200,000); Birmingham (1,000,000); Liverpool, Manchester, Sheffield (over 500,000); Leeds, Bristol, Kingston upon Hull (over 300,000).

In the main, England is a fertile and well-watered land, with a good climate, neither very cold in winter nor very warm in summer. The numerous navigable rivers afford excellent harbors, and there is a great wealth of minerals—tin in the southwest, immense coal-fields in the center and north, and some iron. Nowhere is the sea more than 100 miles distant—protecting the island from enemy attacks and inviting the inhabitants to voyage forth for fish and in commerce.

Today this tiny island country—only a little bigger than Cuba, a fourth the size of France, a little larger than Newfoundland, or about the same size as the state of Illinois or New York—claims as loyal subjects and fellow citizens one-fourth of all the people known to be in the wide world—an empire "on which

the sun never sets"! War and commerce, the explorer's lonely courage, and the colonist's hardy enterprise, have all contributed to its up-building. As a British poet has well said:

Time, and the ocean, and some fostering star,
In high cabal have made us what we are,
Who stretch one hand to Huron's bearded pines,
And one on Kashmir's snowy shoulder lay,
And round the streaming of whose raiment shines
The iris of the Australasian spray.
For waters have connived at our designs,
And winds have plotted with us—and behold,
Kingdom on kingdom, sway on oversway,
Dominion fold in fold!

But please note that we do not say it "governs" one-fourth of all the people living in the world. It permits the people who fly its flag—with minor exceptions—to govern themselves; and that is why, on the whole, it keeps their loyalty and affection. The only countries where it has lost this loyalty—as in Ireland, Egypt, and India—are those where the people have failed to unite on how they want to be governed; and the only country where it had to take down its flag altogether was the Thirteen American Colonies, which declared their independence and became the United States when a stupid and obstinate king, in the first stages of insanity, would not let the colonies govern themselves.

It was because England lost the American Colonies that she never again tried to "rule" her English speaking dependencies, but let them rule themselves. England's history has been full of terrible blunders, but she has always learned from a blunder not to commit the same mistake twice.

Is England great because of her geography, or her soul? Did she conquer the physical facts around her, or was she made by them?

You can't conquer physical facts, any more than you can put your finger in the fire and not get burned. Fire burns and you can't change that fact; but you can use it and make the fire to boil kettles and run steam engines and steamships and factory plants. That is the secret of England's greatness. She used the facts of her history and environment to build up her country's power. Let us see what these facts are that England has harnessed to ride on, like a great steed, to her present wonderful empire. Shut your eyes and pretend you are dreaming, away back before the days Christ walked in Galilee!

Phoenician merchants from the Mediterranean come beating over the waves in long ships rowed by slaves chained to the oars—through the narrow Strait of Gibraltar, up the Spanish coast, and across to a little unknown land only 21 miles across from Gaul (modern France). They find a strange wild blue-eyed people, dressed in hides, with shields of skin so thick and hard an arrow could scarcely penetrate. These people wore leather sandals and leggings, and dyed or tattooed their bodies with a blue weed called "woad." They belonged to the race which we call Celts (Kelts). They themselves were styled "Britons," and the island "Britain."

What the Phoenicians wanted especially from Britain was its tin, so necessary in making the bronze tools and weapons used in that long ago time. Greek

ANCIENT TRAVELERS OF OLD BRITISH ROADS

When the Romans held Britain they left their mark, according to their custom, in well-built roads, many of which are still highways of travel. Here, with the magic of his brush, the artist has brought back upon one of these old thoroughfares the historic figures who traveled over it in the past—the Briton Chieftain with his coat of skins, the Roman legionary, the Saxon invader, the Dane with his horned helmet, and, in the distance, the Norman knight, the last of England's conquerors.

merchants from Marseilles (in southern Gaul) also visited Britain, and finally the Romans learned of it.

The Roman Conquest of Britain

Julius Caesar (55 and 54 B.C.) was the first Roman to lead an expedition to these shores, and he did so because the Britons would come dancing across the narrow waters of the English Channel in cockleshell skiffs and help the Gauls, whom Caesar was then conquering. His first landing was where the white cliffs near Dover may be seen from afar. On his second expedition he penetrated up the Thames to a muddy village where the Celts lived in thatch-roofed cabins, surrounded by dank swamps and thick forests, near what is now London. But it was not until nearly 100 years after Caesar (43 A.D.) that Emperor Claudius sent an expedition which began the real conquest of the island. Only the southern half was really conquered and organized as a Roman province. To keep back the savage Picts and Scots of the north, the emperor Hadrian (121 A.D.) built a great wall of stone across the narrow neck of the island.

South of the great wall, the Romans built numerous roads and some 56 walled cities. They taught the Britons how to plant oats and barley and wheat, and the upper classes became Romanized. For more than 300 years the Britons were under the civilizing influence of the Romans. In this time obscure soldiers and traders introduced the Christian religion, and here and there arose its chapels. Then in 410 A.D. the last of the Roman legions withdrew and the Britons were left to rule themselves, for mighty Rome was now at hand grapples with hordes of Teutonic barbarians.

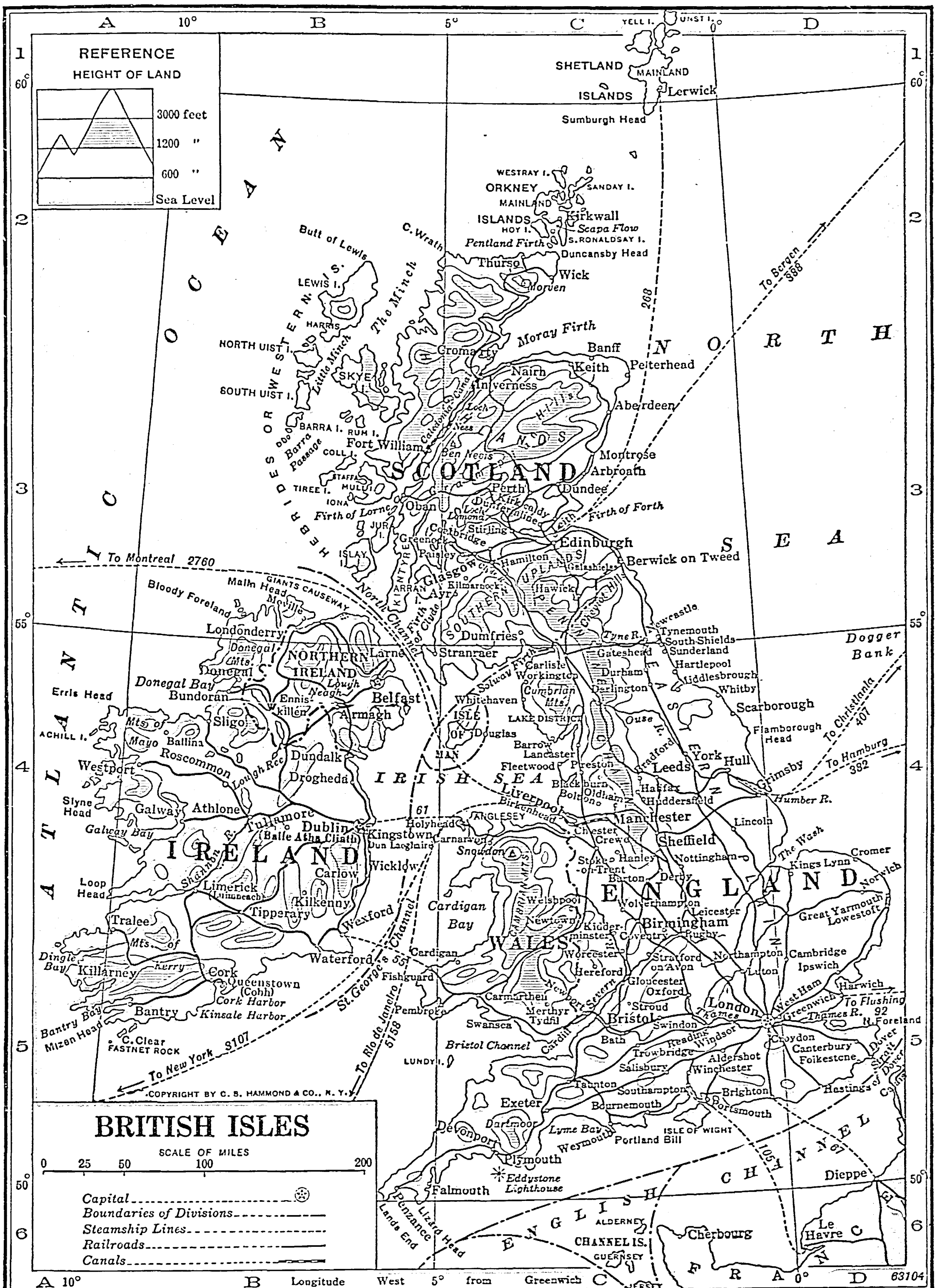
Left to themselves the Britons found they had forgotten how to fight, and were unable to unite under a single government. When their old enemies, the Picts and Scots, began to attack them, they were in despair. In a letter called 'The Groans of the Britons' they wrote for aid to a Roman general, saying: "The barbarians drive us to the sea; the sea throws us back on the barbarians. Thus two modes of death await us; we are either slain or drowned." From the Continent, too, came heathen sea-rovers of the German tribes—Angles and Jutes and Saxons—beginning their conquests about 449 A.D. In the course of 250 years the newcomers possessed themselves of the whole of "Angleland" or "England" (now first so named from the invading Angles).

Everywhere, except among the Celts in Wales and Scotland, the Latin language, Roman civilization, and the Christian religion disappeared. A Teutonic speech and Teutonic institutions—brought with them by the invaders—took their places. Christianity was soon introduced again, chiefly by the monk Augustine and his companions, who landed in Kent in the year 597. Two centuries later (827 A.D.)—just about 1,000 years ago—the scattered English kingdoms were for the first time united into a single kingdom, soon to be made illustrious by the glorious name of Alfred (*see* Alfred the Great). Danish raids and settlements troubled the land for over a century, but Alfred checked their advance, and his successors reconquered the "Danelaw" in which these Northmen were settled. In the 11th century there was a second wave of Danish conquest, and under Canute and his two sons the whole of England was for a quarter of a century under Danish rule (*see* Canute). But presently the old Saxon line was restored in Edward the Confessor, so the Danish invasions merely strengthened the liberty-loving strain in the English people.

Then in 1066 came the Norman Conquest. William of Normandy, claiming that he had been promised the throne of England, defeated and killed the elected king Harold, at the battle of Hastings, and conquered the

KINGS AND QUEENS OF ENGLAND

SAXON LINE			
802–839.	Egbert.	925–940.	Athelstan.
839–858.	Ethelwulf.	940–946.	Edmund I.
858–860.	Ethelbald.	946–955.	Edred.
860–866.	Ethelbert.	955–959.	Edwy.
866–871.	Ethelred.	959–975.	Edgar.
871–899.	Alfred the Great.	975–979.	Edward the Martyr.
899–925.	Edward the Elder.	979–1016.	Ethelred "the Unready."
DANISH LINE			
1016–1035.	Canute (Cnut).	1035–1040.	Harold.
1040–1042.	Hardicanute.		
SAXON LINE			
1042–1066.	Edward the Confessor.	1066.	Harold II.
NORMAN LINE			
1066–1087.	William the Conqueror.	1100–1135.	Henry I.
1087–1100.	William II.	1135–1154.	Stephen.
PLANTAGENET LINE			
1154–1189.	Henry II.	1272–1307.	Edward I.
1189–1199.	Richard I.	1307–1327.	Edward II.
1199–1216.	John.	1327–1377.	Edward III.
1216–1272.	Henry III.	1377–1399.	Richard II.
HOUSE OF LANCASTER			
1399–1413.	Henry IV.	1413–1422.	Henry V.
1422–1461.	Henry VI.		
HOUSE OF YORK			
1461–1483.	Edward IV.	1483.	Edward V.
1483–1485.	Richard III.		
TUDOR LINE			
1485–1509.	Henry VII.	1547–1553.	Edward VI.
1509–1547.	Henry VIII.	1553–1558.	Mary.
1558–1603.	Elizabeth.		
STUART LINE			
1603–1625.	James I.	1625–1649.	Charles I.
1649–1660.	Commonwealth.		
1660–1685.	Charles II.	1689–1702.	William III.
1685–1688.	James II.	1702–1714.	Anne.
HANOVERIAN LINE			
1714–1727.	George I.	1820–1830.	George IV.
1727–1760.	George II.	1830–1837.	William IV.
1760–1820.	George III.	1837–1901.	Victoria.
HOUSE OF SAXE-COBURG-GOTHA (WINDSOR AFTER 1917)			
1901–1910.	Edward VII.	1936.	Edward VIII.
1910–1936.	George V.	1936– .	George VI.



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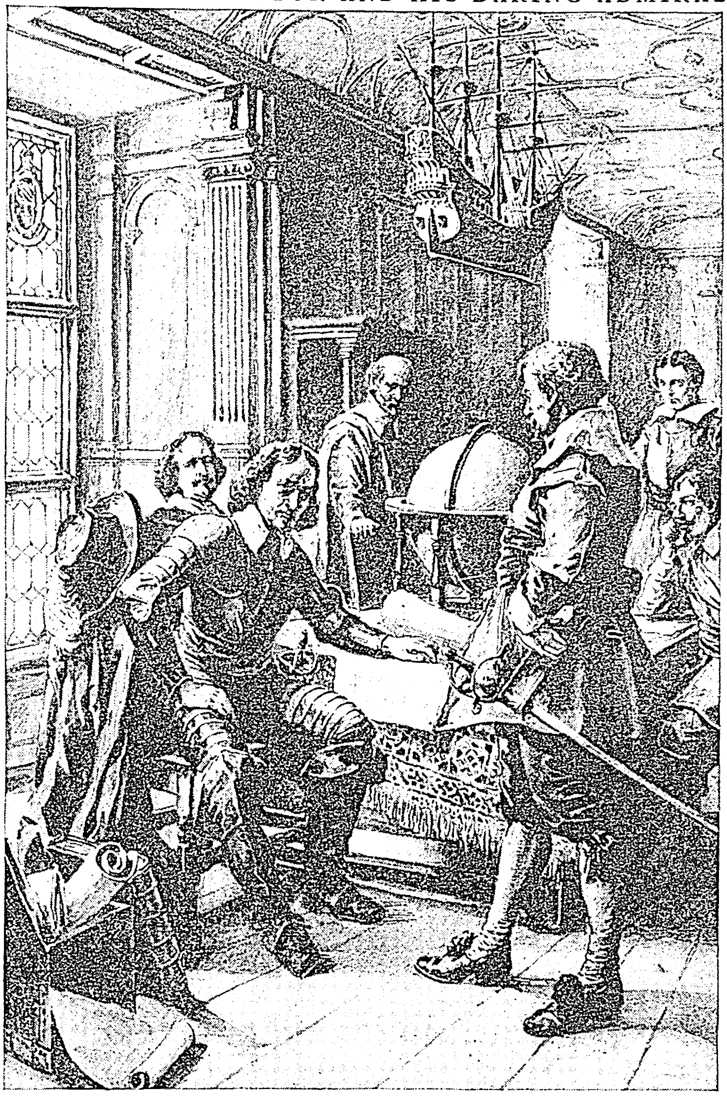
country (*see* William, Kings of England). Half the land was divided among William's followers. Everyone who received or kept land directly from the king (the "barons") had to swear allegiance to him and supply him with soldiers. Feudalism prevailed (*see* Feudalism). Within a century and a half the Normans became English; the conquered absorbed the conquerors. The old laws and customs and language of the Anglo-Saxon triumphed over the Norman-French, though they were considerably changed. By that time the Plantagenet kings, descended from the Conqueror's granddaughter, were reigning. The kings never made new laws or managed to get money in new ways without consulting the Council of the leading men—a Saxon fashion. When King John tried to do otherwise, the powerful barons made him set his seal to Magna Carta (1215), which meant that no one, not even the king, had a right to break the law or change it without the Council's consent. Then the Council became Parliament. Members elected to represent the bigger towns and the counties or "shires" were summoned to attend it, as well as the greater barons, whose right to attend was already established by custom. This change was given its final shape by Edward I (1295). Soon after that, Parliament definitely divided into the House of Commons and the House of Lords (*see* Parliament). The long Hundred Years' War with France (1337–1453) and the Wars of the Roses (1455–85) are described in separate articles.

THE LORD PROTECTOR AND HIS DARING ADMIRAL



Of all the long line of men who, by their skill and daring, made England mistress of the sea, Robert Blake, who is here seen receiving his commission from Oliver Cromwell, in 1649, as commander of the Parliamentary fleet, is one of the most striking and picturesque. On one occasion with 20 ships he defeated the great Dutch Admiral Tromp with 45. On another, with only 40 ships, half of which were useless for want of men, he fought Tromp who had 80 fighting vessels and 10 fire-ships and withdrew undefeated; then later defeated Tromp in a three-day battle. His last and greatest feat was the destruction in 1657 of the Spanish treasure fleet which each year carried the gold and silver of the Americas to Spain. The fleet lay in the Bay of Santa Cruz (Canary Islands) under the protection of formidable forts with guns, and Lord Clarendon says of the feat: "It was so incredible that all men who knew the place wondered that any sober man would have undertaken it."

When Columbus in 1492 discovered America for Spain, the Tudor king Henry VII sat on the English throne. This nation of sea-rovers, with harbors opening on the Channel, on the Humber, on the Thames, on the Bristol Channel, with the love of the sea and the love of freedom in their very souls—took to the sea like fish to water and seized upon the opportunities offered by the New World. England had then a population less than New York City today. London, although a great mart for traders, was little more than a mud-hole sprawling on both sides of the Thames; Liverpool was a village; Bristol was a good-sized seafaring town of perhaps 8,000 to 10,000 people.

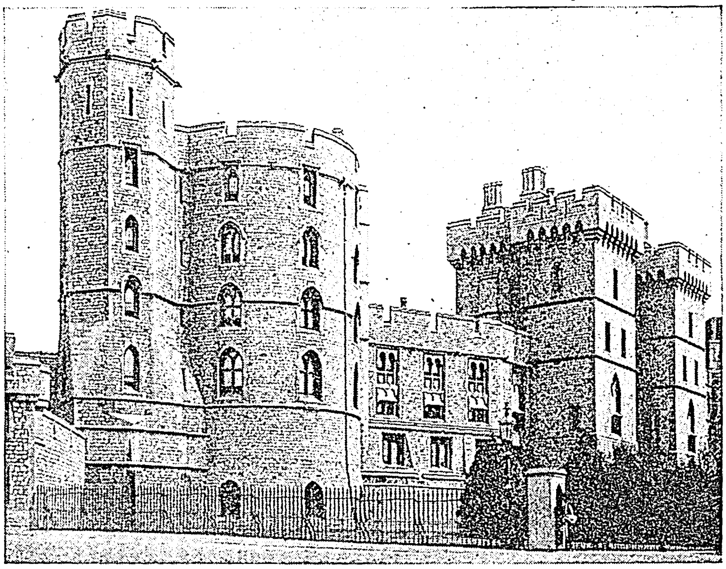
In 1588 something else happened in Europe to change this little island's destiny. England defeated the great Spanish Armada (*see* Armada, Spanish) through the leadership of those very sea-rovers who already in the person of Sir Francis Drake, had plowed a silver furrow around the oceans of the world.

This left England mistress of the seas. The sea was her wall against attacks and wars which devastated continental Europe. Her greatness lay over the paths of the sea; and in the souls of her sons was

the passion of a race that had learned to fight and die for liberty.

But wars and religious persecutions on the Continent were driving the suffering peoples abroad; and to many of these under the influence of her own

HOME OF ENGLAND'S KING AND QUEEN



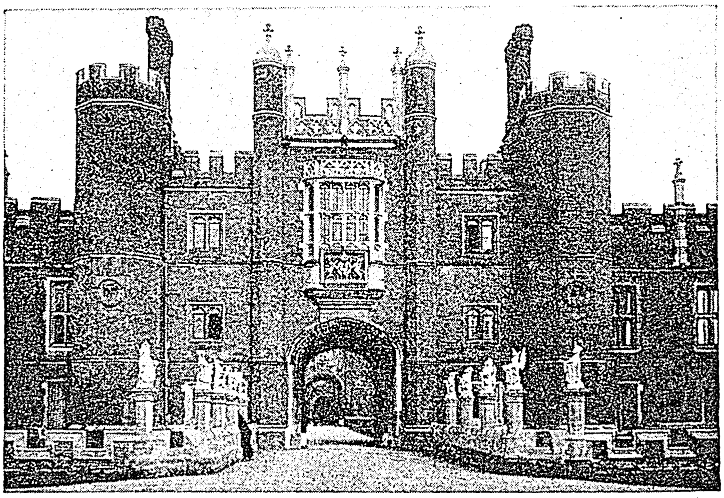
Windsor Castle stands on the site of one of William the Conqueror's forts. Rebuilt by Edward III, there have been many subsequent additions.

Reformation, England threw wide her gates as a port of refuge. Flemings had already come from the Netherlands and taught the English the arts of weaving, lace making, metal-work, and watch making. Exiled French Huguenots carried to England the secrets of French manufactures and hatred of Louis XIV. Jews from as far east as Constantinople reëstablished themselves in England in the days of Cromwell, and gradually made London a center of world banking and finance. East began to meet West, not in Alexandria (Egypt) nor in Constantinople, which had fallen before the Turk, but in London, always protected from attack by the sea. Still the migrations of oppressed peoples kept up —artisans, bankers, traders, sailors of the deep seas from every quarter of the globe. Protection from war and attack, love of liberty, freedom guaranteed by the law to all subjects—these were the magnets that drew the peoples of the earth to the shores of the snug little island, whether she was ruled by semi-despotic Tudor and Stuart kings, by a military republic or "Commonwealth," as in the day of Cromwell, or under strictly limited kings imported from Germany, as under the Hanoverian Georges after the year 1714. Thus England became the great mart of the world's commerce—the place to which all nations might send what they had to sell and from which they might take away what they wished to buy.

Mistress of the seas from the time she defeated the Spanish Armada in 1588, England soon had yet greater need to be the strongest naval power in the world. She now (1763) wrested from France a colonial empire in Canada and India (*see* French and Indian War) to add to her existing Thirteen Colonies, and shortly afterwards laid the foundations by discovery and settlement of her wide domains in Australia and New Zealand. It was her dominance of the seas as shown at Trafalgar (1805) that defeated Napoleon far more than the battle of Waterloo (1815). No wonder the embittered and defeated French emperor called her "a nation of shopkeepers." She was and is, but in the best and noblest sense of that term.

Then began in England that tremendous change which we call the Industrial Revolution, when Englishmen invented machines that enormously increased production and changed the economic and social face of the world (*see* Industrial Revolution). Until the close of the 18th century England's economic life had rested almost exclusively upon agriculture and trade. Now, in a single generation, England became the greatest industrial country in the world. Why? Chiefly because

BEAUTIFUL HAMPTON COURT



Here we are at the gateway of Hampton Court Palace, one of the finest examples of Tudor brick architecture. It was built by Cardinal Wolsey and so attracted Henry VIII, who had an unpleasant way of taking whatever he wanted, that the Cardinal thought it wise to make him a present of it. It is the largest royal palace in Great Britain. Here was held the Hampton Court Conference in 1604, which preceded James I's persecution of the Puritans.

she possessed enormous supplies of coal and iron ore, the basic factors in shaping the new industrial era. Most of the coal-fields of England lay in the northern

and northwestern counties, which soon displaced all other sections in importance. Since coal was necessary to run the steam engines which in turn drove the machinery in the factories, these were built in the coal counties. Around the factories sprang up new towns where the workers lived; and many small towns in this district—Manchester, Leeds, Sheffield, Birmingham—became large and populous manufacturing cities. Manchester, a city of 40,000 in 1774, increased to 271,000 by 1831. Two-thirds of England's cities with more than 100,000 population are in the industrial north.

In this region, which for centuries had been the most thinly settled and the most backward part of England, a dense and busy industrial population grew up. Less in size than Florida, England so increased in population that by the census of 1931 she had 37,800,000 people, more than four times the population of 1801. London had almost as many people as did the entire country 130 years earlier.

Wealth from Exports

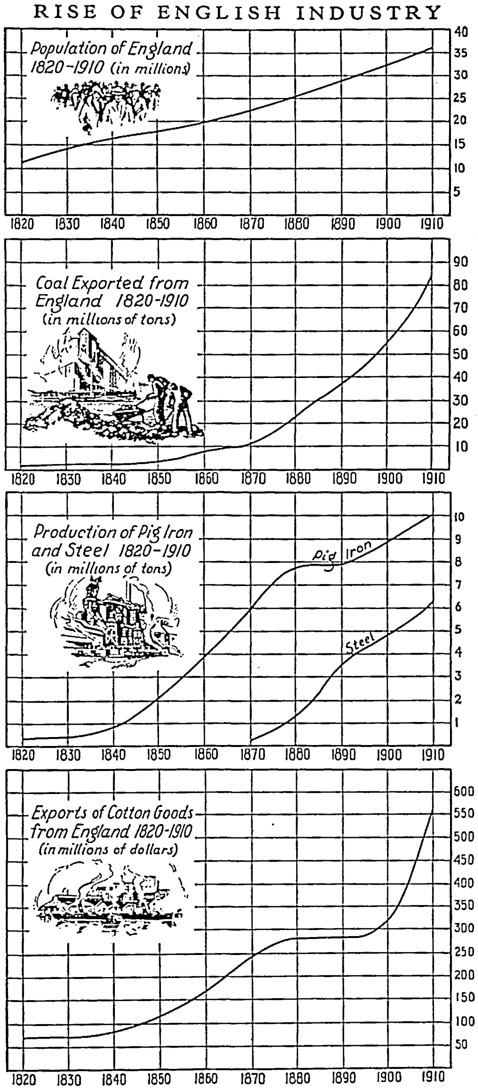
Thanks to her plentiful supply of coal and iron, her abundance of capital, her splendid harbors, her large merchant marine, and especially to her leadership in invention, England in the first three-quarters of the 19th century easily outdistanced all other countries in economic development. Because of these advantages England had little to fear from the competition of other countries, and gradually she removed most of her customs duties on imported articles and became a free-trade nation. She changed into a huge trading organization on a world scale.

What did England sell to the world? Her most important exports were textiles. Great mills in Lancashire produced enormous quantities of cotton, woolen, and linen goods. Manchester alone is said to have one-third of all the cotton spindles in the world. India and China were the chief purchasers of English cotton goods, but Europe, too, bought large quantities of the better grades. Next to cotton ranked woolens, the best market for which she found in the United States.

Only slightly less important than textiles among England's exports were iron and steel goods, produced chiefly in Birmingham and Sheffield. Between 1820 and 1880 her production of iron increased nearly 20 times, and she stood unchallenged in this field. Hardware of all sorts, from shingle nails to heavy steel rails, was made and sold to all parts of the world. Any boy who examined his pocket-knife was likely to find that it was made in Sheffield.

Indispensable to the steel and iron industry was coal. By 1914 ten per cent of England's population was deriving its living from the coal mines. Coal was provided not only for England's factories but for export to other countries. Approximately one-third of the coal mined in England before the World War was sold abroad, and constituted about one-tenth of the value of England's exports. Mediterranean countries which were lacking in coal were especially valuable customers. Newcastle became the "coal capital of the world," and the phrase, "carrying coals to Newcastle," came to be applied to actions which were considered highly useless or absurd.

RISE OF ENGLISH INDUSTRY



Notice the steady increase in products and population during the 90 years of greatest prosperity.

English Imports

But what did England buy from abroad? From the United States, Egypt, and India she bought raw cotton; from Australia, wool; from the Far East, teas and spices. Across the seas England drew the various commodities which she did not produce but which she needed to feed her factories or her factory workers. For as the English people turned more and more to factory production and world trade, they ceased to raise enough food to support themselves. From the Americas and Russia, England bought cereals and beef; from Australia, mutton; from France, vegetables; from Holland and Denmark, dairy products.

For this trade England herself provided ships. She became the world's greatest maritime country, transporting not only her own products but those of other countries as well. About half of the world's sea-borne trade is carried in English ships. The shipbuilding industry and the carrying trade ranked second in importance only to England's foreign trade. Then, too, England came to be the world's banker. The pound sterling was the standard

Two Thousand Years of English History in Outline

B.C.	
55–54.	Julius Caesar invades Britain.
A.D.	
43–410.	Romans rule Britain. Insurrection of Queen Boadicea put down (61 A.D.).
449–700.	*Anglo-Saxons conquer the land* ("Angle-land" or England).
597.	St. Augustine reintroduces Christianity.
827.	England united under one king (Egbert of Wessex).
878.	Alfred checks the raids of the Danes.
1016–1042.	Danes rule England (Canute).
1066.	*Duke William of Normandy conquers England;* Feudalism introduced.
1154–1189.	Henry II (Plantagenet) rules over England, and holds Normandy, Anjou, Aquitaine, etc., in France. Conquest of *Ireland* begun.
1199–1216.	John loses Normandy and Anjou; forced to grant *Magna Carta* (1215).
1282.	Edward I conquers *Wales;* calls Model Parliament (1295).
1314.	Edward II defeated by Scots at Bannockburn; attempt to conquer *Scotland* fails.
1337–1453.	*Hundred Years' War with France.* Victories at Crécy (1346), Poitiers (1356), Agincourt (1415); Henry V king of France as well as England, 1420; *Joan of Arc* turns the tide against the English (1429–31).
1381.	Revolt of peasants under John Ball and Wat Tyler.
1399.	Richard II overthrown by Henry IV (House of Lancaster).
1450.	Jack Cade's Rebellion.
1455–1485.	*Wars of the Roses* (red rose of Lancaster against the white rose of York).
1485.	Henry VII (Tudor) defeats Richard III (York) at Bosworth and ends the war. Strong monarchy established.
1534.	*Henry VIII breaks the ties which linked the English church to Rome.*
1553–1558.	Mary restores the Roman Catholic church.
1558–1601.	*Elizabeth establishes the Church of England;* great development in industry, sea power, and literature (Shakespeare).
1588.	*Spanish Armada defeated.*
1603.	*Scotland united with England* in personal union under *James I* (Stuart).
1642–1649.	*Civil War between Parliament and King Charles I,* over religion and rights of Parliament; *Charles beheaded,* **1649;** England becomes a Commonwealth (republic).
1653–1658.	*Oliver Cromwell* rules England, Scotland, and Ireland as "Lord Protector."
1660.	*Stuart line restored in Charles II.*
1688–1689.	*"Glorious Revolution"* drives James II from throne, establishing Protestant succession.
1701–1713.	*The War of the Spanish Succession.* Preserves the Protestant succession for England, curbs the power of France, and paves the way for the increase of England's colonial empire (Marlborough's victory at Blenheim, 1704). Peace of Utrecht, 1713.
1707.	*Union of England and Scotland* into the kingdom of *Great Britain.*
1714.	*Hanoverian line* succeeds to the throne in George I. Supremacy of Parliament firmly established; gradual growth of *cabinet government.*
1745.	Rebellion of Stuart adherents ("Jacobites") in Scotland and England put down.
1755–1763.	*War with France* (part of Seven Years' War on Continent; in America called French and Indian War) *founds the British Empire. Canada* conquered; British supremacy in *India.*
1760.	Accession of *George III;* attempt to rule arbitrarily by means of corrupt party known as "the King's Friends."
1764.	*Industrial Revolution* begins with Hargreaves' invention of the spinning jenny.
1775–1783.	*Thirteen American Colonies revolt* and establish their independence with the aid of France.
1788.	British begin to colonize *Australia.*
1793–1815.	*Wars with Revolutionary France and Napoleon* (victory of Nelson at Trafalgar, 1805; of Wellington at Waterloo, 1815).
1801.	Irish Parliament abolished and Irish members added to Parliament of Great Britain (thenceforth styled *United Kingdom of Great Britain and Ireland*).
1806.	Cape Colony conquered from the Dutch; beginning of *British South Africa.*
1829.	Catholics readmitted to Parliament.
1832.	*Great Parliamentary Reform Act* gives control to the middle class. A large number of social and political reforms follow (*slavery abolished,* 1833; numerous factory laws, etc.).
1846.	"Corn laws" repealed and *free trade* established.
1853–1856.	Crimean War with Russia in defense of Turkey.
1867.	*Second Parliamentary Reform Act* extends the vote to workingmen.
1882.	British occupation of *Egypt* begun.
1899–1902.	*Boer War* in South Africa. (Formation of Union of South Africa, 1909.)
1911.	Power of *House of Lords* limited.
1914–1918.	*Great World War.* Great Britain and Ireland mobilized 8,000,000 men.
1922.	*Irish Free State* established with Dominion status; independence of *Egypt* recognized.
1924.	*First Labor Government* in history of Great Britain goes into office; remains in power 8 months.
1926.	Dominions recognized as autonomous parts of British Empire; equal in status with Great Britain.
1928.	Voting age for women reduced to 21 (law of 1918 gave vote to those over 30).
1931.	Gold standard abandoned. Free trade policy forsaken for high tariff laws.
1936.	King George dies and is succeeded by Edward VIII, who abdicates in favor of George VI.
1939.	*War with Germany.* Dominions also declare war, but Ireland (Eire) remains neutral.

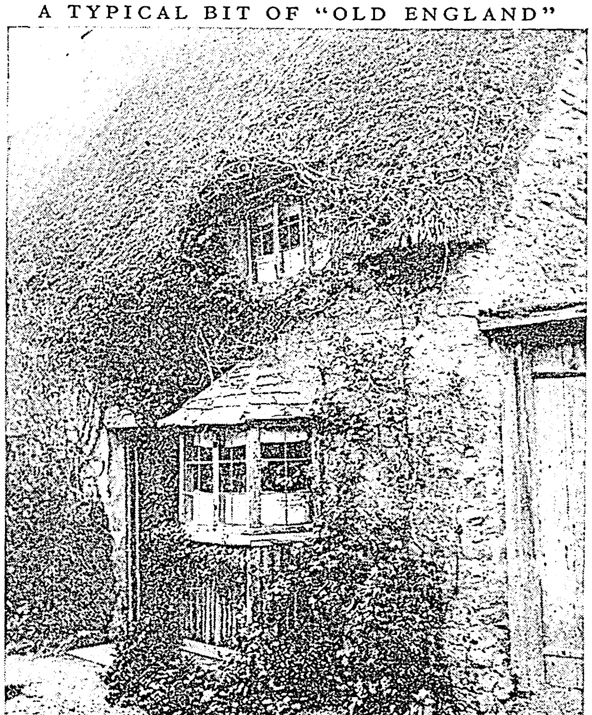
by which other national currencies were judged. In the business of the world the London Stock Exchange occupied a leading position. From all over the world business men and government officials came to London to procure loans, and nearly every large city in Europe had a branch of some English bank. During most of the 19th century England was the industrial, commercial, and financial center of the world.

A New Social and Political Order

Meanwhile the social and political life of England was being fundamentally altered. Those engaged in spinning and weaving under the "domestic system," so well pictured in George Eliot's 'Silas Marner', were forced to give up manufacturing in their private homes and small shops. They could not compete with tireless machines driven by coal-fed steam engines. Many were compelled instead to leave their picturesque hamlets and villages to seek employment in the ugly factories which were so different from anything before known in England. Others were driven to work underground in dark damp coal and iron mines. Agriculture declined and villages decayed. Oliver Goldsmith has pathetically described the changing countryside in his poem, 'The Deserted Village'.

In the 19th century the laborers in factory and mine formed a large part of England's population, with interests very different from those of the farm laborers and artisans of the 17th and 18th centuries. A new class of workmen, the industrial laborer, was created. At the same time, there developed another class called "capitalists." Men like the hero of the novel, 'John Halifax, Gentleman', established and managed factories driven by steam power, and grew wealthy from the sale of their cheaply manufactured products. These capitalists constituted a new social group from which additions to the aristocracy were recruited.

A TYPICAL BIT OF "OLD ENGLAND"



Straw-thatched cottages are one of the prettiest features of the English countryside; for less picturesque, fire-proof materials have not yet elbowed this Old World survival out of existence. Particularly around Dorset, farmers may still be seen leveling and "pegging down" a new thatch of yellow wheat straw. Their handiwork blends into the landscape as though it had grown there.

The appearance of these new social classes soon altered the political life of England (*see* Parliament). In Great Britain and Ireland, before 1832, only about five per cent of all the adult males had the right to vote; and the growing industrial cities like Manchester, Leeds, and Birmingham had no representation in the House of Commons. The new capitalist and industrial classes received a share in the government by the Reform Bill of 1832, which gave representation in Parliament to the new industrial districts. But in the whole kingdom less than 225,000 new voters were created. The workmen then organized in the "chartist" movement to demand universal manhood suffrage, but nearly a century passed before all men and women over 21 years of age were given the suffrage (*see* Lloyd George, David; Parliament; Political Parties).

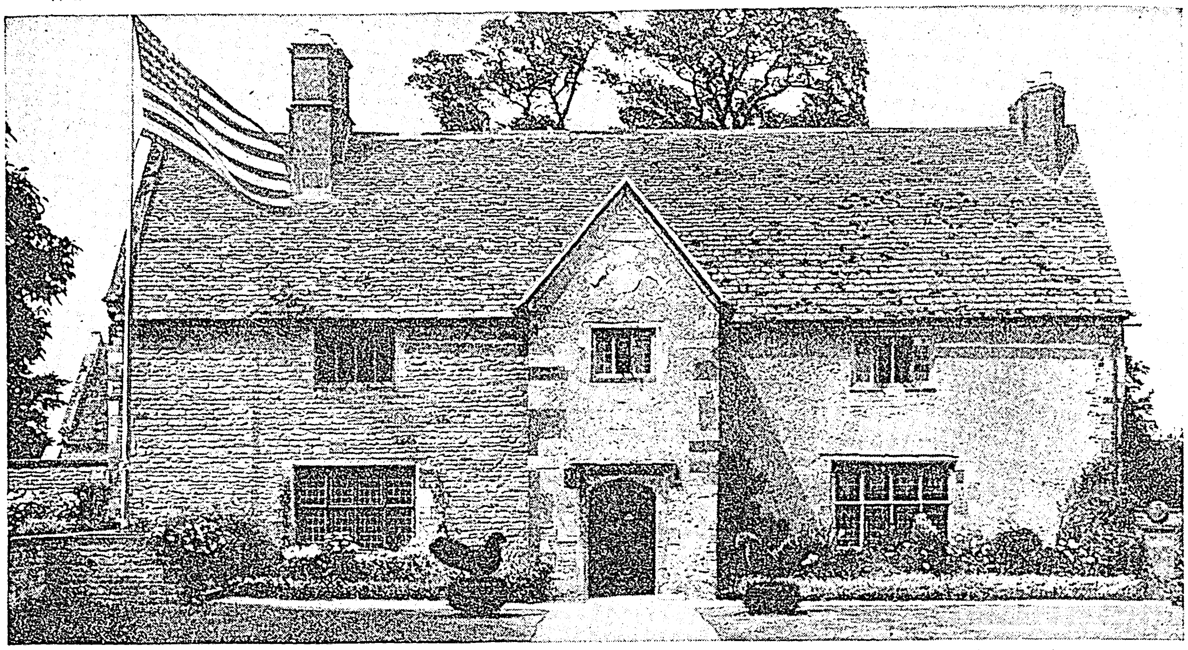
In the early years of the Industrial Revolution the workers suffered great abuses. Men and women were compelled to toil from 12 to 16 hours a day for wages which were kept at starvation levels. Child labor was widespread, and boys and girls not yet in their teens were forced to work under hard taskmasters. Conditions in the factories and in the mines were almost unbelievably injurious to health and menacing to decency. Desire for large profits deafened the ears of many employers, and the government at first only looked on while the helpless workers were exploited.

Eventually, however, the government abandoned its "hands off" policy and began to pass laws in behalf of the workers. Factories were made subject to national inspection, and the employment of women and young children was restricted. Trade unions were legalized in order that labor might be in a better condition to bargain with employers. A public school system was developed to provide better facilities for educating the children of the workers. (*See* Child Labor Laws; Factories and Factory Laws.)

Liberal Reforms

In the decade before the World War the Liberals, led by Lloyd George, put through Parliament a considerable body of social legislation. The employment of children under 12 years of age was forbidden, and the limit was later raised to 14. Workmen's compensation and old-age pension acts were passed. Insurance against sickness and against unemployment in certain industries was introduced. Lloyd George's famous budget of 1909, which was designed to raise money for a "war on poverty," made a definite attempt to shift the burden of taxation from the 90 per cent of the people

WHERE THE "FATHER OF AMERICA" IS HONORED IN ENGLAND



Sulgrave Manor, in Northamptonshire, is the home of the ancestors of George Washington. Lawrence Washington bought it from Henry VIII in 1539 and the Washington family lived here until 1610. George Washington's great-grandfather, who came to Virginia in 1655, was born here. The house was bought in 1914 by a British society and is maintained by an American endowment.

who were poor to the 10 per cent of the people who were wealthy or well-to-do.

The 19th and 20th centuries saw a vast extension of the British Empire and of liberal rule. The English-speaking dominions gradually won self-government, and the empire was transformed into the British Commonwealth of Nations (*see* British Empire).

The World War of 1914-1918 and Its Aftermath

We have seen how England's factories and mills, its far-flung empire, and its control of the seas gave it a position of economic supremacy. At the beginning of the 20th century Germany began to challenge this supremacy by competing for world markets and by building a navy that rivaled the English fleet. It was largely due to fear of the German challenge that England joined France and Russia in war against the Central Powers in 1914. The war crushed Germany and put more territory in Asia, Africa, and the Pacific under British rule. (*See* World War of 1914–1918.)

But victory brought new problems. England emerged from the war with its national debt ten times as great as it was in 1914. The nations of Europe, bankrupted by the war, either could not afford to buy British goods or erected high tariffs to protect their own industries. As a result England's exports dropped far below their prewar volume. Factories curtailed production, wages fell, and prices rose. By the end of 1921, more than 2,000,000 men were out of work. Strikes swept the coal industry, and the unions threatened a general strike if relief was not forthcoming.

Lloyd George's Remedies

In the general elections of 1918, Lloyd George, the wartime premier, was continued in power as head of a coalition government (*see* Lloyd George, David). His greatest concern was to relieve the economic crisis. In 1920 a new Unemployment Insurance Act provided assistance for some 12,000,000 workers earning less than a thousand dollars a year. In 1921 the act was widened and the government thereafter annually contributed millions in "doles" to the unemployed. But such measures could provide only temporary relief until trade should be revived. In 1921 Lloyd George negotiated a limited agreement resuming commercial relations with Soviet Russia. He also introduced tariffs to protect certain key industries against foreign competition.

Meanwhile the wartime coalition was breaking up. In the elections of 1922, the Conservatives deserted it and won a substantial victory. But in their twelve months of power, under Bonar Law and Stanley Baldwin, the Conservatives made only one important contribution to solving the country's problems. This contribution was the Housing Act of 1923, which proved far more effective than previous attempts to remedy the shortage of workers' homes by government assistance. Under this act, almost half of England was rehoused in a few years.

Labor's Rise to Power

The elections of 1922, in which the Labor party received more than 4,000,000 votes, had jolted the nation with the knowledge that this radical and semi-socialist group was the second strongest political party in the country. From its formation in 1906, the Labor party had gained continually in strength. The granting of the vote in 1918 to all men over 21 and to women over 30 brought 8,000,000 new voters to

the polls. Many of them, disgusted with the failure of the older parties to relieve unemployment and the slump in business, turned to the Labor party as the only one capable of curing the country's economic ills.

In 1923 the Conservatives were defeated on the issue of a protective tariff, and Ramsay MacDonald became the head of England's first Labor government (*see* MacDonald, Ramsay). Labor's first term in office lasted only nine months, since it was soon defeated on its program of negotiating further treaties with Russia to take the place of the limited trade treaty of 1921.

In 1929, after a five-year interlude of Conservative rule, Labor again came into power, and held office for 26 months. But in neither of its two periods of office was it able to put through more than a small part of its proposed reform legislation, since it did not have a majority in Parliament and had to depend on support by the other parties. In its second term it was further handicapped by the onset of world depression and the consequent increase of unemployment. The critical financial situation in 1931 finally forced it to resign.

Five Years of Conservative Rule

Between the two Labor governments, the Conservative party held power (1924–29) under the prime ministership of Stanley Baldwin (*see* Baldwin of Bewdley, Earl). Soon after he took office, Baldwin was called upon to deal with a dispute in the coal industry which developed into the greatest industrial struggle in England's history. The owners of the coal mines wanted the miners to accept a wage cut because of the decline in exports. The miners, backed by strong trade unions, refused, and demanded that the government take over the bankrupt coal industry. In 1926 the miners struck, and in support of their demands the unions called a general strike, which lasted nine days. Although the strike was unsuccessful, it frightened a large section of the public. In 1927 the government passed a bill which outlawed picketing and the general strike as weapons of the unions.

The Baldwin government introduced some important social legislation. The voting age for women was reduced from 30 to 21. A system of social insurance provided pensions for workers over 65 years of age or their widows and orphans. The government also reorganized the outmoded system of local government and taxation. By relieving the basic industries of most of the burden of local taxes, the government encouraged businessmen to reorganize their factories along lines that had proved successful in the United States and Germany.

During this period far-reaching changes took place in the political structure of the British Empire. At the conclusion of the World War, there had been nationalistic riots in Ireland, India, and Egypt. Lloyd George had brought temporary peace by creating the Irish Free State (*see* Irish Free State), by according India a greater measure of self-government, and by recognizing the independence of Egypt. The dominions had signed the Versailles Treaty in their own right and had become members of the League of Nations. Now it was necessary to define this changed relationship between the dominions and the motherland. An imperial conference summoned in 1926 to consider this problem declared that the British Empire was a "commonwealth of nations," each equal in status to the others. Later, in 1931, Parliament passed the Statute of Westminster, which acknowledged the absolute right of a dominion to make its own laws and to reject any ruling of the British Parliament. The empire thus became "a league of nations" bound together almost solely by their common allegiance to the crown. (*See also* British Empire.)

Measures of the National Government

England entered the 1930's with its postwar problems largely unsolved. Neither the Conservative nor the Labor governments had been able to restore foreign trade, revive business, reduce unemployment, or balance the budget. The tremendous cost of supporting more than a million permanently unemployed made the British people the most heavily taxed in the world. So serious was the economic collapse in 1931 that party politics were suspended, and Ramsay MacDonald became prime minister of a coalition National government, in which the Conservatives were dominant.

To deal with the economic crisis, the National government threw overboard many traditional policies. The gold standard was abandoned and the value of the pound reduced (*see* Money). The policy of free trade, which England had maintained for some 80 years, was at last dropped, in the face of the trade restrictions adopted by other nations, and a small tariff was imposed on imports from nations outside the empire (*see* International Trade). This was followed in 1932 by an imperial conference in Ottawa, where England agreed to import more raw materials from the dominions in return for favored treatment of its manufactures. The government also granted subsidies to industry and agriculture to increase production. As a result largely of this legislation, the budget was balanced and the decline in exports checked. By 1935 business had regained its 1929 prosperity level.

The National government also advanced the program of educational reform which had been progressing since the World War. In 1918 the age for leaving school had been increased from 12 to 14 years, and in 1936 the government raised the age to 15. Elementary schools, formerly the sole means of education in the small towns, were gradually supplemented with high schools offering a four-year course. By 1940 there were 1,400 such high schools with an enrollment of about half a million students. A liberal scholarship system helped needy students to attend the universities, which formerly had drawn their students almost entirely from graduates of the expensive and exclusive private schools like Eton and Harrow (*see* Education).

The Abdication Crisis

Stirring events rocked the constitutional life of England after MacDonald's resignation in 1935, and

Baldwin's return to power. In 1936 three kings occupied the throne. In January, George V died and was succeeded by Edward VIII, who later abdicated in favor of his brother, George VI (*see* Edward, Kings of England). After Baldwin had steered the country through the critical months of the abdication, he resigned the prime ministership in 1937, and was succeeded by Neville Chamberlain, a fellow Conservative (*see* Chamberlain (Arthur) Neville).

In the Shadow of Approaching War

The menacing European situation now crowded out all other claims to the government's attention. For 15 years after the close of the World War of 1914–1918, England's foreign policy was guided by three major objectives: the preservation of peace through disarmament; the isolation of Soviet Russia; and the reconstruction of Germany, both as a customer for English goods, and as a check upon the power of France and Russia. England attempted to achieve these ends through the League of Nations and by accords such as the Locarno Pact of 1925 in which existing frontiers were guaranteed by all the powers.

Up to 1933, England was highly successful in maintaining in Europe the tranquillity necessary to the country's security and prosperity. But in 1933 Hitler rose to power in Germany, and by 1936 had joined with Mussolini in destroying the balance of power which England had maintained through the League. Fear of a general war, for which England was unprepared and which might endanger the empire, induced the Conservatives to follow a policy of conciliation in the face of the aggressive acts of the two dictators. The Conservatives, moreover, regarded the two fascist nations as a convenient bulwark against communism. Hence England stood aside while Germany withdrew from the League and rearmed. Sir Samuel Hoare, the British foreign secretary, agreed to Italy's invasion of Ethiopia in the hope of winning Mussolini's friendship. Furthermore, when civil war broke out in Spain in 1936 and Mussolini and Hitler gave military aid to the fascist rebels, England persuaded France to join in a policy of nonintervention (*see* Spain).

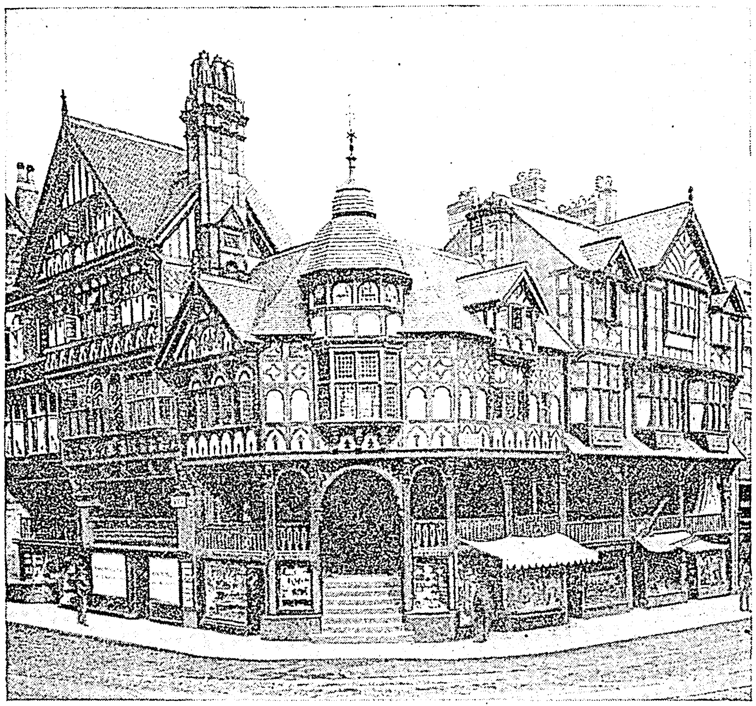
In the Far East also, which traditionally had been regarded as a British sphere of influence, England was forced to yield much of its supremacy to Japan. Involved already in the European situation, England offered little opposition to Japan's conquest of Manchuria in 1931–32 and its effort to conquer the rest of China in a new invasion in 1937. Despite its vast commercial interests in eastern Asia and despite the contemptuous mistreatment of its subjects by the Japanese armies of occupation, England, menaced by approaching war in Europe, was compelled to recognize Japan's "special requirements" in China.

Chamberlain's Appeasement Policy

Aggression in Europe and the Far East and the challenge of Germany's new military might caused Chamberlain in 1937 to launch a five-year rearmament program costing more than 7 billion dollars. Nevertheless, he persisted in the policy of making concessions to the dictators, which he called "appeasement." In protest against this policy, Anthony Eden resigned as foreign secretary in February 1938. The following month Hitler seized Austria. When Germany followed this coup by demanding the Sudeten areas of Czechoslovakia, France and Russia declared that they would fight to defend Czechoslovakia, their ally, against attack. In the ensuing war crisis Chamberlain assumed the rôle of mediator. He arranged a series of conferences with Hitler which ended in a meeting at Munich Sept. 29 and 30, 1938, attended also by Premier Daladier of France and by Premier Mussolini of Italy. There Chamberlain withdrew support from the Czechs and they were forced to cede the Sudetenland to Germany (*see* Austria; Czechoslovakia).

But when Hitler six months later violated his pledge to Chamberlain that he had no further territorial claims in Europe and partitioned what was left of Czechoslovakia, British opinion demanded that the government abandon its appeasement policy. Chamberlain

ANCIENT HOUSES AND "ROWS" OF PICTURESQUE CHESTER



These half-timbered buildings in the heart of Chester are famous, not only as survivals of domestic architecture three centuries ago, but also because they preserve a plan of building which some authorities date back to Roman times. The front of the first story of these structures and their neighbors is occupied by galleries or "rows" open to the street, forming a continuous arcade with shops behind.

responded by joining with France in offering to defend by force of arms the independence of nations which should choose to resist aggression. The pledge was specifically extended to Poland on Mar. 31, 1939, and later, after Italy's invasion of Albania, to Greece, Rumania, and Turkey.

The Prelude to War

Hitler replied by denouncing the Anglo-German treaty of 1935, under which Germany had agreed to limit its navy to 35 per cent of the size of the British fleet. At the same time he defied the British guarantee to Poland by demanding Danzig and a route through the Polish Corridor. Chamberlain countered with a warning that if Germany attempted forcibly to annex Danzig or any part of Polish territory, Poland would have the armed support of Great Britain.

In the ensuing months of crisis, Chamberlain sought vainly to bring about direct negotiations between Germany and Poland for settlement of their dispute. But when Germany signed a nonaggression pact with Russia, Chamberlain converted the verbal pledge to Poland into a formal alliance in which each nation agreed to render assistance to the other in the event of aggression. Then, on September 1, Germany invaded Poland. Chamberlain demanded the immediate withdrawal of German troops. When this ultimatum was refused, Great Britain and France on September 3 declared war on Germany. Within a week the entire British Empire except Ireland (Eire) joined Great Britain in the war.

Unity at Home for War Abroad

England now girded itself for a "war that will last three years or more." As symbols of new unity, the Liberal and Labor parties announced their support of the Conservative government, and the major political parties agreed to suspend parliamentary and municipal elections for the duration of the war. To place the country on a wartime basis, the government took control of every aspect of the national life, regimenting communication, transportation, and industry almost as strictly as was done in the totalitarian states. England also engaged in a far-reaching program of economic coöperation with France, whereby the two nations operated almost as a single unit in the fields of foreign trade and finance.

Except for Germany's lightning conquest of Poland in September 1939, the early months of the war were quiet. England transported an expeditionary force to France, and the Allied armies waited behind the Maginot line for the Germans to attack. Meanwhile the British fleet imposed a far-flung blockade of Germany's imports as well as exports (*see* Blockade).

Expelled from the Continent

In April 1940 Germany invaded Denmark and Norway. To Norway, which declared war, the British dispatched expeditionary troops; but they were unable to halt the German advance and soon they abandoned the country (*see* Norway). Then on May 10 the Germans marched into the Low Countries. The same day Chamberlain resigned as prime minister in favor of Winston Churchill (*see* Churchill, Winston).

Germany's swift onslaught threatened the British expeditionary force in Belgium with annihilation. But England saved most of its troops by a remarkable evacuation from Dunkirk (*see* Dunkirk). As the German army routed the French, Italy entered the war on Germany's side. Then on June 16 the French government asked for a separate peace (*see* France).

After the fall of France, Great Britain became the object of furious German aerial attacks. These were intended to "soften" the British before an attempt to invade the island by land and sea. But these bombings failed to crush the nation's spirit or to demoralize its industry, and the long-heralded German invasion was postponed.

In the eastern Mediterranean regions, England fought desperately to save the Suez Canal and forestall a German advance to the oil of the Near East. It was unable to prevent Axis conquest of Greece, but it held its enemies in Libya, won back Ethiopia, took Syria with the aid of the Free French, and established itself in Iraq and Iran.

Powerful Allies and a New Foe

Until June 1941, the nation was fighting, almost single-handed, against the combined might of Germany and Italy. But when Hitler decided to invade Russia, the British gained an ally of almost inexhaustible strength. And, in December, Japan's attack in the western Pacific brought in all the might of the United States, as well as that of the Dutch colonial government and several Latin American countries.

British troops were now fighting all over the world, in coöperation with the others of the 26 "United Nations" at war with the Axis. As the Pacific became a theater of war of equal importance with Europe, and as it became clear that victory depended in the long run on the effort of the United States, Washington rather than London became the strategic center of the global war. (*See also* Roosevelt, Franklin D.; World War, Second; and **England, History,** in FACT INDEX at the end of this volume.)

Cities, Industries, and the Countryside

NOW let us look a little more closely at the historic land itself. England is the most densely populated country in Europe, with an average of 742 people to the square mile; and more than four-fifths of the people live in cities and towns. Yet it is still, especially in the southern part, like a garden. More than half the land is cultivated, mostly in small farms of less than 50 acres. Its great forests have nearly all disappeared, so that England today has to import its timber from Canada and other lands. But there are still tracts of open moor and fenland that stretch for miles; and here and there are great parks and patches of woodland, where deer roam as in the days of Robin Hood. Richmond Park, on the Thames

just west of London, covers 2,255 acres of magnificent forest and broad meadow; while Epping Forest, another royal deer forest, a dozen miles northeast of London, has an extent of more than 5,000 acres, and is also in the fullest sense a people's playground. The great ducal estates which dot the "midlands" especially, though not so freely open to the public, help to give England an air of spaciousness.

The Canadian or American who visits England will probably land at Liverpool, one of the world's greatest commercial cities. At its long gray docks he will see ships from Africa and Australia, from China, from India, and from South America—from every great port in the civilized world (*see* Liverpool). If it is summer, the traveler will want to see something of the country before going to London, and will turn aside perhaps to visit quaint old Chester on the River Dee, near the border of Wales. Once a Roman camp, as its name tells us (for Chester comes from the Latin *castra*, meaning camp), its medieval walls follow on three sides the line of the old Roman walls; while its queer shops and old timber-built houses with projecting upper stories make it one of the most picturesque of English towns.

In Manchester—like Liverpool a part of Lancashire—we reach the metropolis of the great cotton industry. Through its huge ship canal, which connects the city with the Mersey and Liverpool, making Manchester practically a seaport, come steamers laden with bales of raw cotton, chiefly from the United States, to be sent on to Oldham, Bolton, Preston, and other neighboring towns to be spun and woven into cotton goods. Why should the Lancashire region be given over so largely to the cotton manufacture? The answer is to be found partly in its moist climate—the wettest in all England—which is particularly favorable to cotton spinning; and partly in the great coal fields that lie on either flank of the nearby Pennine Range.

IN THE LAND OF THE LAKE POETS

Who wouldn't be a poet amid scenery like this? Here we are in northwestern England, on the borders of Lake Windermere, made famous by the School of the Lake Poets, of which Wordsworth was the founder and inspiration. Outside of London and Edinburgh no part of the British islands is so identified with distinguished names in English literature as this region, in which are situated all the principal English lakes.

If you were to fly over England in an airplane, you would see a vast smoky district stretching from Cardiff in Wales to the River Tyne on the northeast coast, and on the west coast to Glasgow and the Clyde district, in Scotland. In the heart of this area the factories of Manchester belch forth their grime. Along the Trent River in northern Staffordshire is the district known as the Potteries. Here lie the Five Towns made famous by the novels of Arnold Bennett. Blacker and smokier than anyplace else would appear the Midland district about Birmingham and its suburbs—the "Black Country" of southern Staffordshire, Worcestershire, and Warwickshire. Here, clustered about coal and iron beds, are England's largest iron and steel mills, chemical works, and glass works. This is the greatest metal-manufacturing cen-

THE HEAD OF THE BRITISH LION

A few minutes' study of this map will make clear some of the geographical factors that have helped shape English history. First and foremost, the British Isles are surrounded by the sea, which serves as a barrier to shut out enemies and as a highway for commerce. The sunken coastline provides many good harbors, and the tidal rivers provide easy communication with the interior. The smallness of the country—it is less than half as large as Texas—has impelled its crowded people to cross the seas and found new colonies, until today the British flag waves over a quarter of the earth's land surface. Observe that the chief highland areas are in Wales and Scotland. This explains why the Welsh and Scotch have retained the old Celtic racial character in far greater degree than the lowland people, who became fused with their Teutonic and Norman conquerors. The Irish, too, have remained predominantly Celtic, thanks to the water barrier that separates Ireland from its sister island. The position of the islands with reference to continental Europe gives them exceptional commercial advantages. They command the English Channel, which is the chief maritime artery of European commerce, and thus have easy access to the chief European ports.

ter in England and perhaps in the world. Sheffield, 75 miles to the north, in the corner of Yorkshire, has similar advantages, making it the world's center for cutlery. Today, to be sure, there is no longer enough iron in England to supply the needs of these industries; but England has the coal and she says to Spain and Sweden, "Give me iron ores and I'll give you textiles and other manufactures." In this same humming region are others of England's great industrial cities—Nottingham, known for its laces; Huddersfield, Halifax, and Bradford, with their world-renowned woolen mills; Leeds, the leading cloth market of Europe, and also a city where heavy machinery of all kinds is turned out. If shipping and trade constitute one leg by which England strides to greatness, manufacturing is certainly the other.

Among the Lakes where the Poets Lived

But tiring of this bustle and smoke of factories, let us tarry a bit in the beautiful Lake District of Westmoreland and Cumberland, just north of Lancashire. Here, in the northwest of England, is the country made famous by Wordsworth and the other "Lake Poets," Coleridge and Southey. Within a space of about 30 miles square are the largest lake and the highest mountain in England—Lake Windermere, $10\frac{1}{2}$ miles long, and Sca Fell, 3,210 feet high. The numerous lakes—some with steep rock-bound shores, and others with softened wooded banks—show a charming variety, while the hills and mountains rise in sweeping lines from green meadows and woods.

As we approach the Scottish border, we find a reminder of Britain's early history in the remains of the old Roman wall, stretching from a point on Solway Firth west of Carlisle to what is now the busy city of Newcastle on the Tyne—a distance of $73\frac{1}{2}$ miles. Many miles of this great wall still stand, shorn it is true of more than half its original 20 feet of height, but still a carriage-road in width and striding majestically over hill and down dale as in the proud old Roman days.

The Cathedrals of England

Less than 20 miles south of Newcastle on the eastern side of the island is the old episcopal city of Durham. Here stands the hoary cathedral, "half church of God, half castle 'gainst the Scot," which today is the finest existing example of a Norman Romanesque church.

As we travel southward now, we come upon many more of these picturesque old cathedral cities, each with its own individual character. York, the seat of England's other archbishop, has the largest and perhaps the grandest of all English Gothic cathedrals. Hull, on the Humber River, owes its importance to its naval arsenal, fisheries, and commerce; but Lincoln, some 50 miles farther south, presents a cathedral which historically is even more interesting than that of York. Almost four centuries have been built into the great structure, beginning with early Norman days and reaching down into the late Gothic period. The Lichfield Cathedral, in the very heart of England, where once spread the Saxon kingdom of Mercia, is one of the smallest, but also one of the loveliest of these old churches that delight the heart of every New World visitor; and Ely, with its massive Norman towers, rising in the great fen district of Cambridgeshire—now drained and cultivated—is one of the most majestic and impressive of these shrines.

Not far from Ely is the university town of Cambridge, with its historic old halls; it ranks in fame and educational importance with its sister university, Oxford, on the upper Thames, 100 miles to the southwest (*see* Oxford).

Seventy-five miles from Cambridge we come at last to roaring bewildering London—the mightiest metropolis in all the world, the capital of the whole British Empire, and a place where the traveler will wish to spend weeks and months in historical and literary pilgrimages (*see* London).

The Black Country which we saw in the north is a new England created less than 150 years ago by the Industrial Revolution, and it is the home of manufacturing, democracy, and religious dissent. In the pleasant Thames valley and the region south of it we find ourselves at last in the England of agriculture—the land of the Tory squire and the secure domain of conservatism and the church of England. Here is the traditional England of green meadows and hedgerow-bordered fields, where villages of quaint thatched cottages are lorded over by stately manor houses.

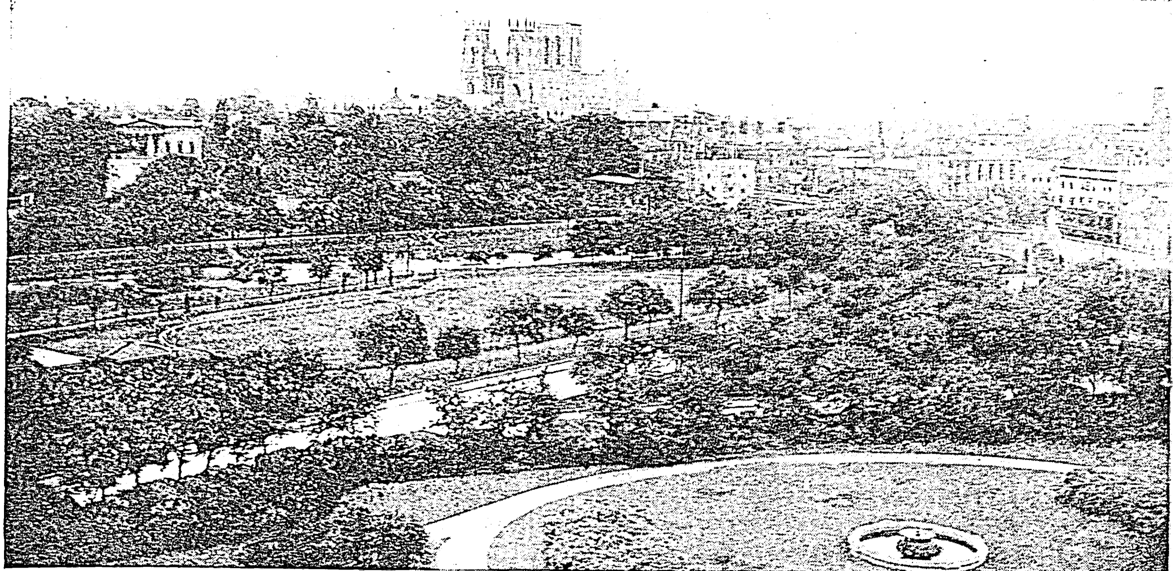
The Historic South and Its Hedgerows

Let us now sail down the broad estuary of the Thames, with its myriad ships coming and going on the world's commerce, and turn southward about Kent to skirt the beautiful and historic shores of the southern coast. In Kent the conquering English first landed nearly 15 centuries ago, and there St. Augustine set up his see of Canterbury, the mother church of England. In Sussex, once the kingdom of the South Saxons, William and his Normans set foot on their great invasion six centuries later. Then comes Hampshire, with the Isle of Wight lying off its harbor of Southampton Water, and with the great naval station of Portsmouth at its mouth. What scenes of Britain's naval glory have these waters witnessed, from the time when Drake and his fellows swept up the channel in the wake of Spain's slow-moving Armada, to the review of Britain's mighty fleet on the eve of the World War!

In picturesque Devonshire we come to old Plymouth, name-city for the Pilgrim Plymouth of New World history. Then comes Cornwall and Land's End. And up the west coast a bit we reach the broad Bristol Channel, leading to busy Cardiff, the shipping point for the coal from the rich South Wales field, and Bristol, once the chief port of western England. Sixty miles away, on a little tributary to the Severn River, lies Shakespeare's Stratford; and in less than a day's walk from there we come to Warwick with its showy castle, and Kenilworth, once the scene of splendid revels in mighty Elizabeth's honor.

Everywhere, indeed, in this "tight little island" we come upon traces of historic greatness, vistas of scenic

LINCOLN AND ITS GREAT CATHEDRAL



A ride of 130 miles north from London brings you to Lincoln on the north bank of the river Witham, whose history, like that of Chester, goes back to Roman days. Rising from the crown of the hill on which it stands, you see from afar the glory of the town and one of the chief glories of English architecture—the cathedral or "Minster" of Lincoln.

loveliness, evidences of far-flung empire. To an American traveler the fact is never absent that he is in an old country. He feels that he is in a land of traditions as well as of historic monuments—in a land where things are done in a certain way because of long established custom. But equally he feels that, beneath the superficial fixity of English social and political life, there is a sturdy vitality and common sense and a fluidity of institutions that permit of far-reaching changes by the orderly processes of public discussion and parliamentary legislation, which in other lands could come only by bloody revolution. Truly England is a land where "Freedom slowly broadens down from precedent to precedent"; but at need the progress can become amazingly rapid. Today England is a limited monarchy; but in it political democracy exists to an extent unsurpassed anywhere in the world, and should the people ever demand another form of government they could easily obtain it by peaceful means. (*See* Cabinet; Parliament.)

ENGLISH LANGUAGE. There is an old saying in Europe that Italian is the language to use when you want to sing, French when you want to make love, and English when you want to do business. This is only a popular saying, of course, and not more than half true, but it does show that different languages have different characters just as different people have, and that each one has a different taste to the mind.

It is true enough that English is a good language in which to do business, for probably—taking into account Great Britain, her colonies, and the United States—the greater part of the world's commerce is conducted in English. But English is good for many other uses besides business. Indeed it is one of the richest languages spoken today, with more variety and flexibility than almost any other, and it is spread over a greater part of the earth's surface. English is made up, like the people that developed it, of many national inheritances and foreign importations, and its history and growth make a very interesting study.

Have you ever dug a hole beside a stream and seen the different layers you find as you dig, sand and gravel and small stones one above the other? If you study down into the English language you will find that it was formed in much the same way.

Of course in speaking we do not notice these layers at all. The words are all mixed together, so that often in a single sentence you will say words that come from all the different layers. If you say for instance, "My mother received a good telegram," you have used words from four different sources. "Mother" is a very old word and comes from the original Indo-European root language; "received" is a word of Latin origin; "good" is a Teutonic or Anglo-Saxon word; and "telegram" is from the Greek.

English is classified by philologists or scientists who study words as a Teutonic or Germanic language. This is not because more of our words are Teutonic —as a matter of fact not more than one-fourth of the words in the dictionary are Teutonic—but because the Teutonic words are the framework of the language, the connecting words and the simple fundamental names of ordinary things. So that in spite of the fact that only one-fourth of our words are Teutonic in the dictionary, in ordinary speech about four-fifths of the words we use are Teutonic. Another reason is that we put our words together with the grammatical construction of the Teutonic languages.

After the Teutonic words the most important are the words of Latin origin which have come to us either

from the Latin direct, or through the French or Italian or Spanish, but especially French. These words have a different feeling from the Teutonic words when you know them. They are more polished, more stylish you might say, more precise. At one time the Normans, who spoke French, came over and conquered England and ruled over the Teutonic people, the Anglo-Saxons, who lived there. So it came about that the words the common people used stayed Anglo-Saxon or Teutonic and the words of the wealthy and ruling classes became Latin. For instance as long as a sheep was alive and was tended by the shepherds, who were common people, it was called by the Teutonic word "sheep," but as soon as it was cooked and came on the table of the noble classes, it became "mutton," a French word. In the same way "cow" is Anglo-Saxon and "beef" is French; "hog" is Anglo-Saxon and "pork" is from the language of the conquerors. The influence of the church, the classical Renaissance of the 16th century, and the later coining of scientific terms from the Latin, greatly increased this element in English.

One great advantage which English has over many other languages is the ease with which it forms new words out of old by simply joining them together, as in "rainfall," "railway," "backslide," outcome," "daisy" (from "day's eye"). It is also rich in prefixes and suffixes which can be added to existing words to modify their meaning. Thus we form nouns by the use of such suffixes as *-ness*, *-dom*, *-age*, *-tion*, *-ment*, *-or*, *-ess*, giving us such words as "wickedness," "kingdom," "porterage," "accusation," "amazement," "actor," "prioress." The suffixes *-al*, *-ic*, *-ous*, *-able*, *-ful*, *-ly*, etc., are used to form adjectives, as "critical," "pedantic," "famous," "approachable," "tuneful," "lovely." The prefixes *anti-*, *pro-*, *re-*, *inter-*, *un-*, and a host of others enable us to make such useful words as "anti-slavery," "pro-Boer," "reclassify," "interurban," "unnecessary."

The Force in Our Mother Tongue

In general the words of Latin origin are not as strong or as full of meaning as the Teutonic words. For instance the Anglo-Saxon "friendship" has its Latin equivalent "amity," which means just the same thing, but it is a pale word and not nearly so good for most purposes. In poetry, where the color of words is very important, Anglo-Saxon words are usually better than Latin words. But the Latin words have the advantage of being more exact and scientific and for certain purposes are better.

The Greek words are much fewer in number and are largely scientific words, like "geology." We have a number of Dutch words, particularly about the sea, like "schooner"; Scandinavian words (mostly from the old Danish conquest), like "earl," "take," "window"; a few Indian words, like "tomahawk"; some Hebrew words, like "hallelujah"; a good many from the Arabic, like "alcohol"; and an assortment of odd words from almost every other language. We have, too, a few words made up out of whole cloth to describe new things, like "gas" and "kodak," and others, like "buzz," "splash," "chick," are imitations of the sound of things. Some words, too, are names of people, like "sandwich," which came from the Earl of Sandwich, who was too busy gambling to eat regular meals and invented the quick lunch we call by his name; and "boycott," named after an Irish land agent who was its first victim.

Anglo-Saxon the Basis of English

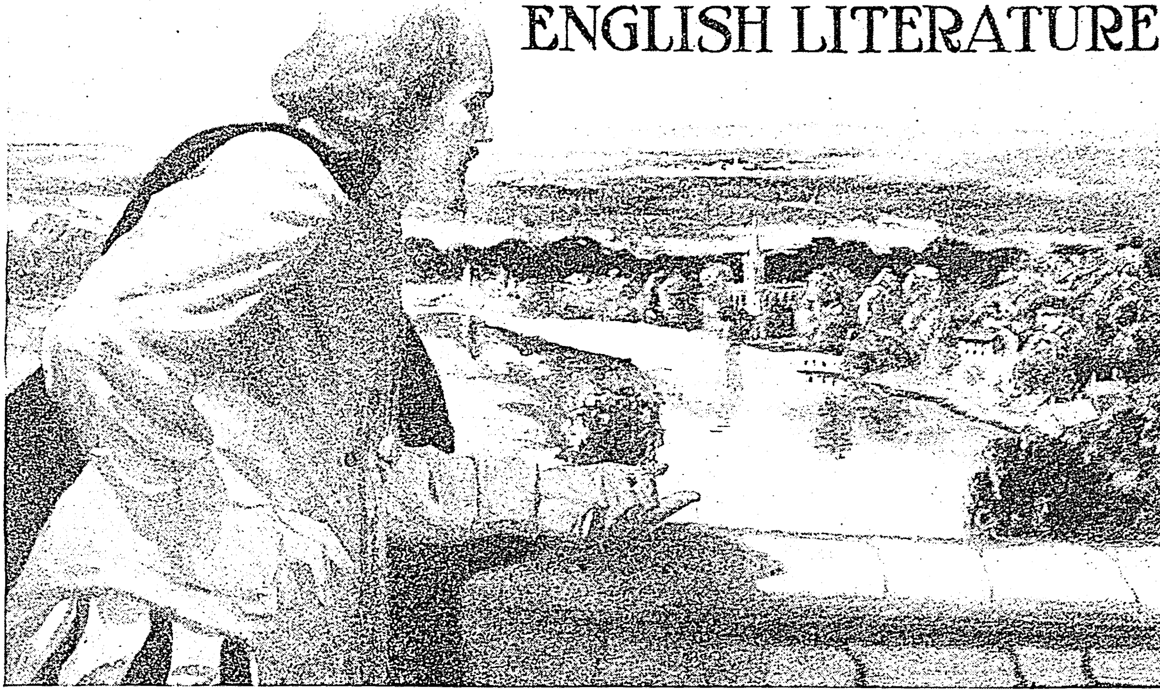
The language of the old Britons was Celtic and survives in modern Welsh, which is still the tongue of Wales. When the Romans conquered England they introduced a certain number of Latin words in the three centuries that they ruled the island. But when the Anglo-Saxons came over from the north of Europe they brought their own Teutonic language with them, which is the basis of English, and there was very little admixture of Celtic and Latin from the conquered inhabitants. The earliest written examples of this Anglo-Saxon are from the 7th century.

The periods in the development of the English language are called Old English (or Anglo-Saxon), Middle English, and modern English. Old English was spoken from about 449 A.D. to 1100, and was very highly inflected—that is, it had a complicated system of grammatical changes to indicate case, number, person, tense, and the like. Middle English was spoken from about 1100 to about 1500, and was much less highly inflected; and modern English, which has developed since 1500, has lost its inflections almost entirely. English speech supplanted French in Parliament and in the law courts of England in 1362.

There have always been, and are today in fact, though now they are only dialects, three varieties of English spoken in England—Northern, Southern, and Midland English. Northern English was important in the very early days and later developed into the Scotch dialect, such as you find in Robert Burns's poems. Southern English was the most important in the Old English period, especially under King Alfred. Modern English developed out of Midland English, in the Middle English period, which stood about halfway between the two. The poet Chaucer, who wrote in Midland English, and the King James Version of the Bible and the English Book of Common Prayer did much to set modern English in the form it now has. Since about 1500 the written language in most important respects has been much as it is today. But the spoken language often differs considerably from the literary tongue, and every age and region has its own dialect, or slang expressions (*see* Slang).

How many words are there in the English language? In the ordinary unabridged dictionary you will find from 300,000 to 500,000, but of course no one person ever uses all of these. It has been calculated that Shakespeare, who had a very wide vocabulary, used not more than 24,000 words in his writings, and 5,000 of those he used only once. Milton uses 17,000 words, and the English Bible only 7,200. In ordinary life few persons use more than 2,000 or 3,000 words. The Greek poet Homer paints all his marvelous pictures of battle and adventure by land and sea with about 9,000 words. (*See also* Philology.)

The Glorious Pageant of ENGLISH LITERATURE



WHAT a wonderful heritage is left to the world in the works of the great writers of England! A strong free people of high ideals, with a faculty for absorbing the best from the races they have touched, the English have embodied these traits in their literature, making it one of the great literatures of the world. Here the absorbing story of the rise and growth of this great body of prose and poetry—from the early Anglo-Saxon hero-tales to the floods of fiction, poetry, drama, and essays that today pour from the printing presses of Great Britain—can only be sketched in briefest outline. But in the separate articles scattered throughout this work, on the lives and works of the important writers, you will find the means of filling in with life and warmth this bare skeleton.

ENGLISH LITERATURE. The dawn of English literature began back in the times when the Angles and Saxons still lived in Jutland and along the North Sea shores, and spoke a Teutonic language that no one can read now without studying it as he does a foreign tongue. In the middle of the 5th century these peoples —the Anglo-Saxons—came to Britain, conquered the Celtic inhabitants, and drove them westward. They brought with them a mass of tales in verse, sung by wandering minstrels in camp and hall. 'Beowulf', one of these anonymous tales, was finally written down by some unknown singer, and thus becomes the first landmark in English literature. The first poet whose name has come down to us was Caedmon, who made a metrical translation of parts of the Scriptures about the year 670. The greatest prose writer in Anglo-Saxon was good King Alfred, who translated Latin textbooks for his people and started the 'Anglo-Saxon Chronicle'.

The Normans, who conquered England in 1066, brought with them the French language. But being of the same original stock as the English they gradually united with them, and the language of the country became English modified and enriched by French. Wyclif's translation of the Bible (1380), the most important prose work of the 14th century, set a standard of English prose and made it the people's language of religious thought. During those years while the language was forming, the old Welsh legends of King Arthur became popular, chiefly through the Latin writings of Geoffrey of Monmouth, a Welsh monk, the date of whose death was probably 1154.

England's First Great Poet

Geoffrey Chaucer (1340?–1400) is England's earliest great poet. He belongs to the springtime of English poetry. His 'Canterbury Tales' give us colorful pictures of people who lived in England then—knight, innkeeper, nun, merchant, and many others—all journeying on a pilgrimage in April, telling stories to pass the time, while—

> . . . smale fowles maken melodye
> That slepen all the night with open ye (eye),

and the fresh and charming English countryside blossoms around them in all its beauty.

The years of the 15th century, after Chaucer, though they showed in England no important writings, were a busy time of preparation. All Europe was awakening to the renewal of classical learning; for the Greek and Roman literatures, lost to western Europe for nearly a thousand years, were now brought to light. The invention of printing, brought to England by William Caxton, made it possible to spread books and knowledge abroad. The world was growing larger, too, for that century saw the beginnings of the age of discovery. Fearless men were seeking truth in religion, and the Reformation was being prepared. (*See* Reformation, Protestant; Renaissance.)


CHAUCER
England's First Great Poet

In England the New Learning was represented by the famous Dutch scholar Erasmus (who came to England in 1497), by John Colet, the learned and lovable dean of St. Paul's, and by Sir Thomas More, England's wittiest Lord Chancellor. More's 'Utopia', though written in Latin, reflects English thought about society and religion. The Reformation worked great good to the English language, for William Tyndale's translation of the Bible helped to fix the standard of English speech and literary style.

There was little new poetry in that time, but Caxton's printing press spread broadcast the work of Chaucer and other native poets of merit. Caxton printed, too, Sir Thomas Malory's 'Morte d'Arthur', an English prose translation of Arthurian legends compiled from French sources. In the lowlands of Scotland some poetry was written, the best by William Dunbar; and this Scottish strain, with its warmth of feeling and love of nature, was a powerful influence on the writers of a later day.

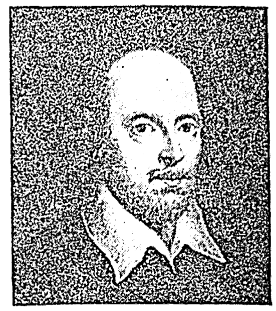
The Glorious Age of Elizabeth

All these new influences—renaissance of learning, religious reformation, travel, discovery, invention—worked rather slowly on English literature. But in Elizabeth's time (1558–1603) they flowered out in the most wonderful creative period in the history of English writing. Poems, ballads, masques, and pageants, the ancient classics and new romances and verse forms brought home by travelers in Italy, stories of voyages, books of religious reform, the Bible in English—all supplied inspiration, and England became a land of poets.


SPENSER
Author of 'Faerie Queene'

Edmund Spenser's 'Faerie Queene' finely embodies the wonder, freshness, and beauty of the age, with nothing ugly or coarse. It is a long story-poem of the adventures of the Red Cross Knight and other knights who personify the virtues fighting against evil. Spenser's work is pure and true, and rich in passages of delicate beauty.

For centuries the drama had been growing up gradually, through the "mystery," "miracle," and "morality" plays, presented to teach the people Bible stories, the life of Christ, and the moral virtues. The real English drama began to appear in the later 16th century, with a group of powerful playwrights, of whom our unrivaled Shakespeare was by far the greatest, not only of the period, but of all time to date.

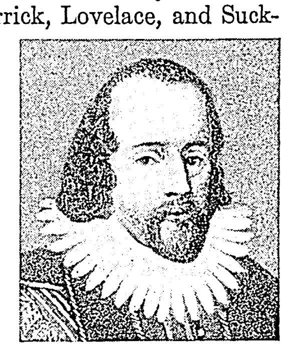

SHAKESPEARE
The World's Greatest Dramatist

Shakespeare "touched life at all points," and something of all he saw and felt went into his plays. King and queen and peasant, wise man and fool, of his own time and of the past, walk before us. We sound the depths of human tragedy in 'Hamlet' and 'Lear'; revel in fairy legend in 'Midsummer Night's Dream'; laugh uproariously with Falstaff in 'The Merry Wives of Windsor'; and wonder at the peaceful beauty of 'The Tempest'. Shakespeare touches every emotion and speaks to all times and nations. Through him England reached its supreme poetic expression.

After Shakespeare's death drama and poetry gradually declined. "Rare Ben Jonson" wrote carefully wrought plays and lovely songs; Beaumont and Fletcher were dramatists with flashes of extreme vigor and beauty; but none had the gift of supreme genius.

Age of Puritan and Cavalier

The times of James I and Charles I, in which the Elizabethan impulse largely persisted despite the rising tide of Puritanism, produced many beautiful lyrics, such as those of Herrick, Lovelace, and Suckling. George Herbert and George Wither found inspiration in religion. The most important prose writer of the time, the one who still speaks to us as forcefully as to his own time, was Francis Bacon, whose profoundly penetrating 'Essays' will "live as long as books last," as he himself foretold. Bacon also originated the method of the new scientific research based on experiment which has led to the wonderful progress of modern science.


FRANCIS BACON
Essayist and Philosopher

The Puritan standards in religion, morals, and government which had been gaining power, at last prevailed in the civil war between crown and Parliament. In the main the Puritan age which followed was more favorable to the development of prose than of poetry, for philosophy, religion, and government were constant subjects of thought and controversy. Yet, though the age was one of argument and contention, it produced Milton, who stands next to Shakespeare in the galaxy of English poets. In his beautiful early poems, like 'Il Penseroso' and 'L'Allegro', Milton's genius is more akin to the spirit of the Elizabethan age than that of his own time. In his 'Areopagitica' (on the freedom of the press) and other prose writings, he serves the cause of liberty. In his sublime 'Paradise Lost' he expresses the Puritan spirit at its loftiest and best. It is England's great epic poem, written in the noblest of blank verse.

MILTON
The Noble Puritan Poet

Another great Puritan, who stands with Milton as a representative of the age, was John Bunyan, the non-conformist preacher who wrote 'Pilgrim's Progress'. This story of Christian's journey from the City of Destruction to the heavenly country is an allegory full of meaning and charm for children and simple people as well as for wiser folk. It has been translated into more languages than any book save the Bible. Three quaint books of the time, sometimes read now for their wisdom and pleasant fancy, are Robert Burton's 'Anatomy of Melancholy', Sir Thomas Browne's 'Religio Medici', and Izaak Walton's 'Compleat Angler', sometimes called "The Bible of Fishermen."

The Restoration and Queen Anne

With the return of the Stuarts in 1660, and the removal of Puritan restraints, some forms of literature showed a natural reaction. The drama especially reflected the immorality and frivolity of the court life. The more serious poetry and prose underwent great changes. Writers felt less and had less to say; so they gave less attention to *what* they said than *how* they said it, emphasizing especially simplicity and directness of style. Their subjects were mainly social and political.

DRYDEN
Great Poet of the Restoration

John Dryden, "the greatest man in a little age," led in the new poetry. His 'Absalom and Achitophel' is the greatest political satire in the language. Dryden also wrote plays, but his great influence has been through his masterly critical essays, which were one of the most weighty factors in the formation of modern English prose style. Samuel Butler's 'Hudibras' was a fiercely satiric poem against Puritanism. In their gossipy diaries, Evelyn and Samuel Pepys give "the very taste and color of life" in their times. There were also far-reaching developments in science, and the Royal Society was founded in 1662. Sir Isaac Newton's 'Principia' began a new age in science, while John Locke's 'Essay Concerning the Human Understanding' opened new fields in philosophy, as his 'Essays on Government' did in political thought.

In the early 18th century, under stupid but good Queen Anne, standards of personal and political morality were low, and there was little left of the old Puritan loftiness of purpose. As in the preceding age, writers were weak in feeling and imagination, and turned largely to satire and criticism. But they laid increasing emphasis on perfection in literary form—clearness, smoothness, and regularity—developing a beautifully elegant and polished prose style. Because of this, the period is one of the great ages in the history of English literature.

Alexander Pope was the preëminent poet, brilliant in satire and criticism. In his 'Essay on Criticism', his 'Rape of the Lock', and his verse translation of Homer, he used the rhymed couplet, then considered the perfect verse, for irregularity and lack of smoothness were counted barbaric faults. Such regularity seems monotonous now, but we still quote Pope for his concise and perfectly rounded sayings.

POPE
Brilliant Satirical Poet

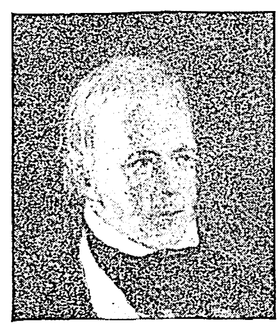
But the reign of Anne was preëminently an age of prose. The most original writer of the day and one of the most powerful satirists of all time was Jonathan Swift, author of 'Gulliver's Travels', which bitterly and mercilessly holds man's faults and weaknesses up to scorn. The periodical essay as developed by Addison and Steele was a new order of writing, which held the germs of three of the most important factors in modern life — the novel, the magazine, and the newspaper. These two men wrote for *The Tatler* and *The Spectator* essays on English life, morals, and manners, ridiculing gently the failings of the age and bringing a tone of culture and good breeding into clubs, coffee-houses, and homes. Sir Roger de Coverley, the English country gentleman, immortalized in a group of the *Spectator* papers, is a well-loved book-character. Addison's kindly humor and smooth elegance make his essays delightful reading.

The kindly human tone of Addison's work is one evidence of changes working in morals and literature.

There was warmer feeling in religion and great emotional preachers like Whitefield and the Wesleys soon were reaching the lower classes. Interest in romance and nature reappeared, in the period 1740–80, in Macpherson's professed translation of the epics of the Gaelic Ossian, and in Bishop Percy's collection of old ballads, the 'Reliques of Ancient English Poetry'. Love of nature animated the poems of William Collins, James Thomson, and Thomas Gray, author of the 'Elegy in a Country Churchyard'. Oliver Goldsmith's 'Deserted Village' has both beauty and feeling, and his play 'She Stoops to Conquer' is full of hearty fun.

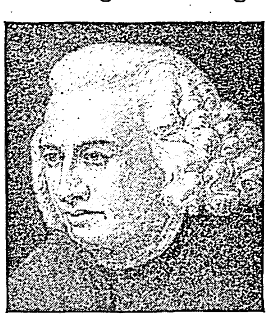
BURNS
"The Scottish Song-Bird"

The character studies of Addison and Steele, the stories of Swift and Daniel Defoe, author of 'Robinson Crusoe', and the revived interest in old-time romance pointed the way to the new form which today provides the greatest part of our literary pleasures—the novel. 'Pamela' by Samuel Richardson heads the list. Henry Fielding, Oliver Goldsmith, Laurence Sterne, and Tobias Smollett all added valuable elements to the new literary type and their novels served as models for those that followed. Goldsmith's charming 'Vicar of Wakefield' (1766) remains a favorite.



SCOTT
Creator of the Historical Novel

But above the literary life of the times towers the huge bulk of Dr. Samuel Johnson, great conversationalist and arbiter of literature. Johnson wrote a 'Dictionary', a series of 'Lives of the Poets', 'Rasselas', and many periodical essays; but his personal influence was far more potent. He, with the artist Reynolds, founded a famous literary club, of which the statesman Burke, Goldsmith, the biographer Boswell, the historian Gibbon, and the great actor Garrick were members. Johnson's own style was ponderous and full of large resounding words. His emphasis on classical severity and dignity held back somewhat the advance of the freer spirit of romanticism with its bold originality and rejection of ancient precedents. Happily (since the man himself is more interesting than his works) we have a remarkable biography of him by his friend and worshiper, James Boswell.



SAMUEL JOHNSON
Huge in Figure and Learning

The old standards could not hold long in a time when men were thinking of freedom, when governments were changing, and the people were making themselves heard. Love of liberty animated all who thought deeply. Literature revolted from its old limitations and found free expression for thought and feeling.

William Blake and William Cowper were forerunners of a new outburst of poetry and prose. From Scotland, whose poets had long loved nature and freedom, came Robert Burns, singing the new brotherhood and democracy—

A man's a man for a' that!

and the love of nature, the tender sentiment and the rollicking humor of his race, in poems like 'To a Mouse', 'The Cotter's Saturday Night', and 'Tam o' Shanter'. Another poet of Scotland was Sir Walter Scott, who put stirring border tales into poems like 'The Lady of the Lake'.

Greatest of all the nature poets was William Wordsworth, who better than anyone else leads one to understand meanings hidden beneath nature's outward forms. To this modern day he speaks most effectively in his beautiful meditative short poems, and in sonnets like—

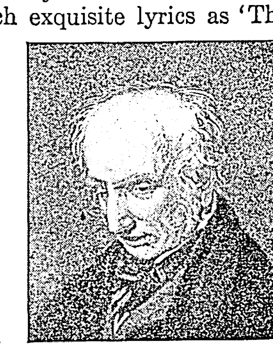
The world is too much with us, late and soon—

Samuel Taylor Coleridge wrote only a few truly great poems, but those few are unexcelled for imagination, penetrating vision, and melody. 'The Ancient Mariner' stands alone in magical rendering of the supernatural and fantastic.

The spirit of revolt that is the outstanding characteristic of the time appears in most intense form in the poetry of Lord Byron, who went his unhappy and tempestuous way, until he died fighting for Greece. 'Childe Harold's Pilgrimage', 'Don Juan', and others of his fiery poems exercised an incalculable influence on the younger writers of his day.

Most ardent of the young poets of liberty was Percy Bysshe Shelley. His longer poems soar into a spiritual region whither not every one will follow him. But we all can enjoy such exquisite lyrics as 'The Cloud' and the 'Ode to the West Wind'. Like his own 'Skylark',—

Higher still and higher
From the earth thou
springest
Like a cloud of fire.



WORDSWORTH
The Poet of Nature

The other poet of this group was John Keats, whose early death Shelley mourns in 'Adonais'. Keats was deeply moved by passionate love of beauty for its own sake. Such short poems as 'On a Grecian Urn' or 'To a Nightingale' have unsurpassed beauty, and such music as—

. . . . hath
Charmed magic casements opening on the foam
Of perilous seas in faery lands forlorn.

At the same time Scott created the historical novel. His thrilling Waverley Novels—'Ivanhoe', 'The Heart of Midlothian', and many others—were the favorites of the age and were read all over Europe. Even today they keep their hold on all who love tales of adventure. Another novelist was Jane Austen, one of the first to write, in her 'Pride and Prejudice' and other novels, interesting stories of commonplace people.

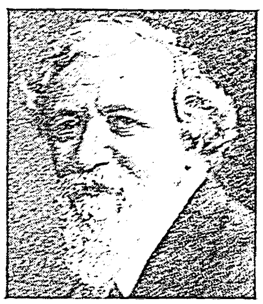
BYRON
Fiery Singer of Revolt

Thomas De Quincey wrote essays in a beautiful and elaborate style. Most lovable of essayists is Charles Lamb, author of the gentle, whimsical 'Essays of Elia'. He and his sister Mary retold for children 'Tales from Shakespeare'.

The Victorian Age and After (from 1837)

By the time Queen Victoria came to the throne, a new age was producing new writers. Scientific discoveries and inventions had revolutionized life. The idea of evolution changed the outlook of science and philosophy and affected religious thought (*see* Evolution). The spread of democracy, of popular education, of social unrest, was reflected in the poetry and prose of the time.

The two chief poets were Alfred Tennyson and Robert Browning. Tennyson wove the King Arthur stories into the 'Idylls of the King', which together make a long poem rich in meaning and imagery, melodious in language. 'In Memoriam' and 'Locksley Hall' mirror the religious and scientific spirit of the day. Browning wrote stirring narrative poems, searching character analyses, dramas, and love poems. He is always confident of the triumph of good. His wife, Elizabeth Barrett Browning, wrote the love poems, 'Sonnets from the Portuguese'.



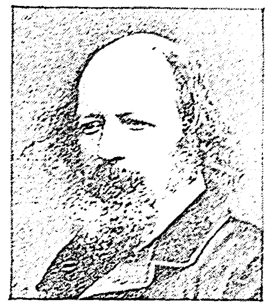
BROWNING
Master of Subtle Meaning

The restraint of Greek art and the mental stress of the modern age were present in the poetry of Matthew Arnold. The pre-Raphaelites, under the leadership of William Morris and Dante Gabriel Rossetti, frankly turned their backs on the present and addressed their poetry to the past. Delicious music and a hedonistic philosophy were the essence of the overluscious poetry of Algernon Swinburne.

DICKENS
Novelist of English Common Life

Matchless among prose authors for clear, forcible, picturesque studies of great men was Macaulay. Thomas Carlyle spoke directly, flamingly, to arouse people to thinking, in his 'Sartor Resartus' and 'Heroes and Hero-Worship'. John Ruskin, Matthew Arnold, and Walter Pater compose a group of critical writers of the first rank.

Prose fiction was now the chief art form and innumerable novels were written. Charles Dickens, author of 'Pickwick Papers' and 'David Copperfield', with his humor, pathos, and understanding of human nature, is one of the best-loved authors. William Makepeace Thackeray, the keen but kindly satirist of English life in 'Vanity Fair' and 'The Newcomes', is scarcely less a favorite. 'Middlemarch', 'Silas Marner', and the other novels of George Eliot, England's greatest woman novelist, all have their problems and serious purpose. Anthony Trollope left an amazing series of novels depicting with wit and fidelity life in the clerical and "county" society of his day. Literary heir of Thackeray was George Meredith, whose brilliant novels, such as 'The Egoist', illuminate the social scene with far more sharpness and pungency than did Thackeray's. Slow-minded readers called Meredith's condensed flashing style "unintelligible" and "obscure."



TENNYSON
Victorian Poet Laureate

The great figure of the period was Thomas Hardy, over whose novels broods a dark, inescapable fate—the fate imposed on man by his own nature, by all the forces of land, sea, and sky. The power of environment, the clutch of the past, wring pure tragedy out of the lives of 'Tess of the D'Urbervilles', 'Jude the Obscure', and all the other stumbling heroes and heroines of Hardy. In 'The Dynasts' this great novelist also showed surprising gifts as a poet.

Robert Louis Stevenson's was a lighter voice, whose sedulously polished style and gift for story-telling concealed the thinness of his matter. 'Kidnapped', 'Treasure Island', 'David Balfour', are swinging tales of adventure; such essays as 'Travels With a Donkey', and his verses for children, never fail to charm.

All the ingredients of popularity were manifest in the swift, bright tales of Rudyard Kipling, in his marching or mocking verse, in 'The Jungle Book', favorite of children. But his complacent vision of England's imperial destiny does not stir the postwar generation.

Changing views of the social order have sifted an ash of theory, propaganda, and sociology over a good bit of 20th century fiction. H. G. Wells began with several first-rate tales, such as "Tono-Bungay", and ended as an inexhaustible evangelist of social theories, a fountain of ideas, suggestions, conjectures. His 'Outline of

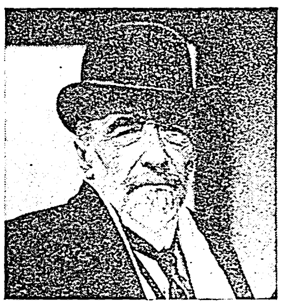
History', intended to establish a new attitude toward history rather than to present new facts, had a tremendous vogue and inspired many similar works.

The "what's-wrong-with-the-world" theme also animated the novels of John Galsworthy. 'The Forsyte Saga' is a humorless, thoughtful, and well-made series of novels about one family, in which he sketches the scene of the upper strata of English pre-war life, and gravely comments upon social injustice.

HARDY
Poet and Novelist

Arnold Bennett, who liked a good story better than propaganda, nevertheless struck many a neat thwack at human stupidity and pride in 'Clayhanger', 'The Old Wives' Tale' and 'Riceyman Steps', the cream of his work, as well as in his farces and journalistic novels.

Joseph Conrad had nothing of the reformer in him, and let the reader make what he liked of the moving pageant of the world, set down as if by magic on the pages of his sea tales, his narratives of political intrigue, and his glowing stories of the tropics. Master of English style, this Pole who wielded a foreign tongue with a power which few Englishmen have equaled, was looked upon as the literary marvel of his day.



CONRAD
Wizard of Style

Fantasy of a delicate sort charmed readers and audiences in the stories and plays of Sir James Barrie. Maurice Hewlett accomplished the difficult feat of making historical characters live in his romantic novels of the past, though his style sometimes cloys like an overstrong perfume.

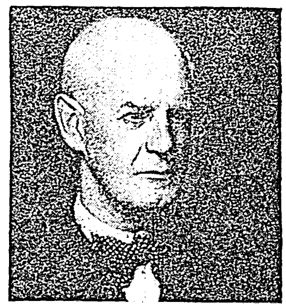
No writer left a stronger impress on his time than did Bernard Shaw, whose flashing, stinging prefaces to his challenging plays pricked Victorian smugness. An Irishman of equal wit but of a very different stamp was George Moore. His exquisite prose suggests both music and fine embroidery. Whether he made use of a political or religious idea, or whether he chose a historical theme, he produced a work of art in a severely simple and almost flawless English.

GEORGE BERNARD SHAW
Who Never Bored Anyone

A third remarkable Irishman, James Joyce, created in 'Ulysses', what has been called the most influential single work of the 20th century. It records 24 hours in the life of a Jewish salesman by means of the "stream of consciousness" device so widely imitated by others. Unrelated wisps of thought, as they float through the consciousness, are set down without apparent pattern.

ARNOLD BENNETT
Brightens the Commonplace

Among the new talents developed in the 20th century D. H. Lawrence stood out as an explorer of the darker reaches of the soul. He infused a gnawing vitality into the strange, obsessed novels he wrought out of his sick, unhappy life. Katherine Mansfield's was a genius, cut short by death, which in such fragments as 'Bliss' showed powers akin to the great Russians. Popularity came to Hugh Walpole for his story-telling instinct, easy style, and for his faithful portraiture of certain types of character. The average reader was puzzled by the novels of Virginia Woolf, cloudy flights in psychology at once vivid and vague. There is as much subtlety and delicate feeling with far more clearness in Frank Swinnerton's 'Nocturne' or Anne Douglas Sedgwick's 'The Little French Girl'. A fine study of Anglo-Indian relations appeared in E. M. Forster's 'A Passage to India', a novel done slowly and thoughtfully by a mind unvitiated by too great facility.



GALSWORTHY
Critic of Society

Ultramodern, cynical, and even bitter was Aldous Huxley, who satirized fashionable London life in 'Point Counterpoint'. Michael Arlen had a meteoric success with a series of clever but thin sketches in the same vein.

Though he was made famous and rich by his plays, it is probably on his novels that the fame of W. Somerset Maugham will rest. 'Of Human Bondage' is all too much like life in its weight and drag and lack of conclusiveness. Another novelist of the seamy

side was Ford Madox Ford in his grim war novels.

When realism and psychological analysis bear down upon the reading public too hard, it is on such delightful stories as 'The Constant Nymph' by Margaret Kennedy that sudden popularity descends. She is one of a large group of recent literary successes which includes Rebecca West, Compton Mackenzie, Sylvia Thompson, Clemence Dane, Francis Brett Young, Rose Macaulay, Rosamond Lehmann, May Sinclair, Sheila Kaye-Smith, David Garnett, E. F. Benson, E. M. Delafield, Hugh de Selincourt, and others.


H. G. WELLS
Who Sought Utopia

Poetry of the period developed a somewhat bewildering interest in all sorts of startling experiments in new forms; and while the outstanding poets, A. E. Housman and John Masefield, clung to the age-old forms of rhyme and rhythm, their subject matter and viewpoints were essentially new. Housman's 'A Shropshire Lad' echoes long in the mind of every sensitive reader, and Masefield's 'The Everlasting Mercy' and 'The Widow in the By-Street', when they appeared, shocked the conservative by the beauty they lent to sordid themes. Unexpected popularity came to A. A. Milne's delicious absurdities 'When We Were Very Young', 'Winnie-the-Pooh', and 'Now We Are Six'.


BARRIE
Master of Puckish Humor

T. S. Eliot, an American who became a British subject, led the modern symbolist school; his 'The Waste Land' aroused a storm of controversy over its startling form and obscure content. Richard Aldington, with 'Images Old and New', was the leading exponent of the imagists.

The war note was of course to be heard in much poetry of the 20th century. Rupert Brooke and James Elroy Flecker were young poets who lost their lives in the waste of war. Siegfried Sassoon, Robert Graves, and Robert Nichols survived to condemn war in verses of bitter realism.


MASEFIELD
Poet Laureate

Robert Bridges, poet laureate 1913–1930, showed extraordinary technical power in creating subtle rhythms and depicting nature. James Stephens played new tunes on old Irish tales, and Padraic Colum and W. B. Yeats likewise developed Irish themes. Sir Rabindranath Tagore of India wrote English translations of his poems which form a part of English literature.

Besides Hardy, Kipling, and Stevenson, a number of other novelists and essayists also occasionally turned out excellent verse, including G. K. Chesterton, Hilaire Belloc, Walter de la Mare, and Alice Meynell.


KATHERINE MANSFIELD
Artist of the Short Story

Chesterton and Belloc led in the field of the witty, provocative, controversial essay, and Max Beerbohm in the gently malicious parody and essay. Alice Meynell's was a delicate and cultivated talent.

In the varied field of non-fiction writing, no piece of work in English was more remarkable than 'Travels in Arabia Deserta' by Charles M. Doughty, which, though written in 1888, took a new lease on life after the publication of 'Revolt in the Desert' by Col. T. E. Lawrence. Lytton Strachey infused new life into the art of biography with his 'Queen Victoria'. His aim was to "remove the whitewash" from historical characters and portray them dispassionately and without bias. Philip Guedalla and a host of others followed him in this field.

Brilliant essays and criticism, as well as fiction, came from the pens of John Cowper Powys and his brother, Llewelyn Powys. Literary critics of distinction were George Saintsbury and Laurence Binyon. The work of the learned George Santayana, born in Spain, who lived for many years in the United States before taking up residence in England, may properly be classified as belonging to English literature, which is enriched by his beautifully written critical studies.

English writers of today show less tendency to experiment with new forms than do those of other countries, but much fine and enjoyable work is being done. The age is too close to us to determine whether any modern writer is truly great, or to know what names will be the most outstanding. The common opinion of contemporary critics seems to be that this is not an age of literary giants. (*See also* List of British Authors on the following pages; Australia; Canadian Literature; Irish Literature; Novel; Poetry. For a Reference-Outline and Bibliography *see* Language and Literature.)


VIRGINIA WOOLF
Psychological Novelist

BRITISH AUTHORS AND THEIR BEST-KNOWN WORKS

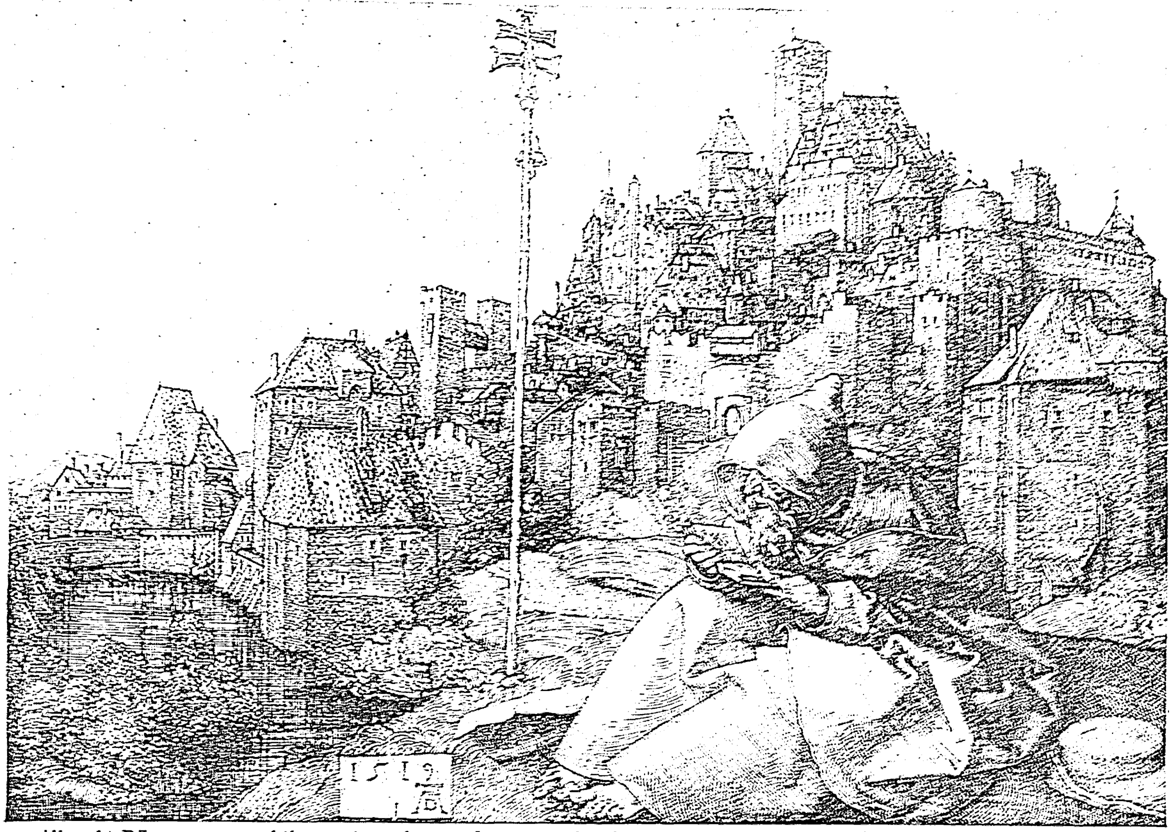
(Note: for dramatists, *see* Drama.)

Joseph Addison (1672–1719), poet and essayist—Sir Roger de Coverley Papers in *The Spectator.*
Richard Aldington (1892–), poet and novelist—'Images Old and New'; 'Death of a Hero'.
Alfred the Great (848–899), translator—Boethius' 'The Consolation of Philosophy'.
Michael Arlen (1895–), novelist—'The Green Hat'.
Matthew Arnold (1822–1888), poet and essayist—'The Scholar-Gypsy'; 'Essays in Criticism'.
Roger Ascham (1515?–1568), scholar—'Toxophilus'; 'The Scholemaster'.
Jane Austen (1775–1817), novelist—'Pride and Prejudice'; 'Mansfield Park'; 'Sense and Sensibility'.
Alfred Austin (1835–1913), poet—'English Lyrics'.
Francis Bacon (1561–1626), philosopher and essayist—'New Atlantis'; 'The Advancement of Learning'; 'Essays'.
Roger Bacon (1214?–1294?), philosopher—'Opus Majus'.
John Barbour (1316?–1395?), poet—'The Brus'.
Sir James M. Barrie (1860–1937), novelist and dramatist—'The Little Minister'; 'Sentimental Tommy'; 'Peter Pan'.
Bede (673?–735), historian—'Ecclesiastical History of the English Nation'.
Max Beerbohm (1872–), essayist and novelist—'More'; 'Yet Again'; 'Zuleika Dobson'; 'A Christmas Garland'.
Hilaire Belloc (1870–), essayist, historian, biographer—'On Nothing'; 'Danton'; 'Richelieu'; 'Many Cities'.
Arnold Bennett (1867–1931), novelist and dramatist—'The Old Wives' Tale'; 'Clayhanger'; 'Riceyman Steps'.
Arthur C. Benson (1862–1925), essayist and biographer—'The Upton Letters'; 'From a College Window'.
E. F. Benson (1867–1940), novelist and children's writer—'The Osbornes'; 'David Blaize'.
J. D. Beresford (1873–), novelist—'The Mountains of the Moon'; 'These Lynnekers'; 'Love's Pilgrim'.
Laurence Binyon (1869–1943), poet and art historian—'The Four Years'; 'Poems of Nizami'; 'Flight of the Dragon'.
William Blake (1757–1827), poet—'Songs of Innocence'.
George Borrow (1803–1881), prose writer—'Lavengro'; 'Romany Rye'.
James Boswell (1740–1795), biographer—'Life of Samuel Johnson'.
Robert Bridges (1844–1930), poet and dramatist—'The Growth of Love'; 'The Testament of Beauty'.
Charlotte Brontë (1816–1855), novelist—'Jane Eyre'.
Emily Brontë (1818–1848), novelist—'Wuthering Heights'.
Rupert Brooke (1887–1915), poet—'Poems'.
Sir Thomas Browne (1605–1682), prose writer—'Religio Medici'.
William Browne (1591–1643), poet—'The Shepherd's Pipe'.
Elizabeth Barrett Browning (1806–1861), poet—'Sonnets from the Portuguese'; 'Aurora Leigh'.
Robert Browning (1812–1889), poet—'The Ring and the Book'; 'Pippa Passes'; 'Rabbi Ben Ezra'.
John Buchan (1875–1940), historian and novelist—'History of the Great War'; 'Greenmantle'; 'Huntingtower'.
John Bunyan (1628–1688), prose writer—'Pilgrim's Progress'.
Edmund Burke (1729–1797), political philosopher—'Reflections on the Revolution in France'; 'On Conciliation with the Colonies'.
Fanny Burney (Mme. d'Arblay) (1752–1840), novelist and diarist—'Evelina'; 'Diary and Letters of Madame d'Arblay'.
Robert Burns (1759–1796), poet—'The Cotter's Saturday Night'; 'Tam o' Shanter'.
Robert Burton (1577–1640), prose writer—'The Anatomy of Melancholy'.
Samuel Butler (1612–1680), satirist and poet—'Hudibras'.
Samuel Butler (1835–1902), satirical novelist and critic—'The Way of All Flesh'; 'Erewhon'; 'Notebooks'.
Donn Byrne (1889–1928), novelist—'Messer Marco Polo'.
Lord Byron (George Gordon) (1788–1824), poet—'Childe Harold's Pilgrimage'; 'Don Juan'; 'Manfred'.
Caedmon (died 680), poet—'Paraphrases' (of the Bible).
Thomas Campbell (1777–1844), poet—'Hohenlinden'; 'Ye Mariners of England'.
Thomas Carlyle (1795–1881), historian and essayist—'Sartor Resartus'; 'French Revolution'; 'Heroes and Hero-Worship'.
Lewis Carroll (Charles L. Dodgson) (1832–1898), children's writer—'Alice's Adventures in Wonderland'; 'Through the Looking-Glass'.
George Chapman (1559?–1634), poet, dramatist, and translator—Homer's 'Iliad' and 'Odyssey' (*trans.*).
Thomas Chatterton (1752–1770), poet—'Rowley Poems'.
Geoffrey Chaucer (1340?–1400), poet—'Canterbury Tales'.
Gilbert Keith Chesterton (1874–1936), poet, essayist, novelist, and critic—'The Man Who Was Thursday'; 'Heretics'.
Samuel Taylor Coleridge (1772–1834), poet and critic—'The Rime of the Ancient Mariner'; 'Kubla Khan'.
William Collins (1721–1759), poet—'The Passions'; 'Ode to Liberty'; 'Ode to Evening'.
Padraic Colum (1881–), poet and writer of children's stories, —'Wild Earth'; 'The Adventures of Odysseus'.
Sir Sydney Colvin (1845–1927), literary and art critic and biographer—'John Keats'.
Joseph Conrad (1857–1924), novelist—'The Nigger of the Narcissus'; 'Almayer's Folly'; 'Youth'; 'Chance'.
Abraham Cowley (1618–1667), poet and essayist—'Pindarique Odes'· 'Davideis'; 'The Mistress'.
William Cowper (1731–1800), poet—'The Task'; 'John Gilpin'.
George Crabbe (1754–1832), poet—'The Village'.
Richard Crashaw (1613?–1649), poet—'Steps to the Temple'.
Cynewulf (8th or 9th century), poet—'Christ'; 'Juliana'.
Samuel Daniel (1562–1619), poet—'Defense of Ryme': 'Hymen's Triumph'.
Daniel Defoe (1661–1731), novelist and journalist—'Robinson Crusoe'; 'Moll Flanders'; 'Captain Singleton'.
E. M. Delafield (Elizabeth M. Dashwood) (1890–), novelist—'Zella Sees Herself'; 'Turn Back the Leaves'.
Walter de la Mare (1873–), poet and novelist—'Memoirs of a Midget'; 'The Listeners'; 'Peacock Pie'.
William De Morgan (1839–1917), novelist—'Joseph Vance': 'Alice-for-Short'; 'Somehow Good'.
Thomas De Quincey (1785–1859), essayist and critic—'Confessions of an English Opium Eater'; 'Literary Reminiscences'; 'Autobiographic Sketches'.
Charles Dickens (1812–1870), novelist—'David Copperfield'; 'The Pickwick Papers'; 'A Christmas Carol'; 'Oliver Twist'.
Benjamin Disraeli, Earl of Beaconsfield (1804–1881), novelist and statesman—'Vivian Grey'; 'Coningsby'; 'Sybil'.
Austin Dobson (1840–1921), poet and essayist—'Proverbs in Porcelain'; 'Old World Idylls'; 'At the Sign of the Lyre'.
John Donne (1573–1631), poet and preacher—'Poems'.
Ernest Dowson (1867–1900), poet—'Cynara'.
Sir Arthur Conan Doyle (1869–1930), novelist—'The Adventures of Sherlock Holmes'; 'Sir Nigel'; 'A Study in Scarlet'.
Michael Drayton (1563–1631), poet—'Agincourt'; 'Poly-Olbion'.
John Drinkwater (1882–1937), poet, dramatist, critic, and biographer—'Collected Poems'; 'The Lyric'; 'Pepys'.
William Drummond (1585–1649), poet and historian—'Flowers of Sion'; 'The Cypresse Grove'.
John Dryden (1631–1700), poet and dramatist—'Astraea Redux'; 'Alexander's Feast'; 'Ode on St. Cecelia's Day'.
William Dunbar (1465?–1525?), poet—'Two Married Women and the Widow'; 'The Dance of the Deadly Sins'.
Lord Dunsany (Edward Plunkett) (1878–), story writer and dramatist—'The Sword of Welleran'.
Maria Edgeworth (1767–1849), novelist—'Castle Rackrent'.
"George Eliot" (Mary Ann Evans) (1819–1880), novelist—'Adam Bede'; 'The Mill on the Floss'; 'Silas Marner'.

T. S. Eliot (1888–), poet and critic—'The Waste Land'.
Havelock Ellis (1859–1939), essayist and critic—'The Dance of Life'; 'Impressions and Comments'.
John Jeffery Farnol (1878–), novelist—'The Broad Highway'; 'The High Adventure'; 'Gyfford of Weare'.
Henry Fielding (1707–1754), novelist—'Tom Jones'; 'Joseph Andrews'; 'Jonathan Wild'.
James Elroy Flecker (1884–1915), poet—'Golden Journey to Samarkand'; 'The King of Alsander'; 'Hassan'.
Giles Fletcher (1588?–1623), poet—'Christ's Victorie . . .'.
Phineas Fletcher (1582–1650), poet—'The Purple Island'.
Ford Madox Ford (1873–1939), novelist and critic—'Some Do Not'; 'No More Parades'; 'Return to Yesterday'.
Edward M. Forster (1879–), novelist—'A Passage to India'.
James Anthony Froude (1818–1894), historical writer—'The History of England from the Fall of Wolsey to the Death of Elizabeth'; 'Thomas Carlyle, A History'.
John Galsworthy (1867–1933), novelist, short story writer, and dramatist—'The Forsyte Saga'; 'Caravan'.
Elizabeth Gaskell (1810–1865), novelist—'Cranford'.
John Gay (1685–1732), poet and dramatist—'The Shepherd's Week'; 'Fables'.
Geoffrey of Monmouth (1110?–1154), historian—'Historia regum Britanniae'.
W. L. George (1882–1926), novelist and essayist—'Caliban'; 'The Second Blooming'; 'Woman and Tomorrow'.
Edward Gibbon (1737–1794), historian—'Decline and Fall of the Roman Empire'.
Sir Philip Gibbs (1877–), novelist and essayist—'The Street of Adventure'; 'The Middle of the Road'.
George Gissing (1857–1903), novelist—'The Private Papers of Henry Ryecroft'; 'The Whirlpool'; 'The New Grub Street'.
William Godwin (1756–1836), political writer and novelist—'Inquiry concerning Political Justice'.
Oliver Goldsmith (1728–1774), novelist, poet, and essayist, —'The Vicar of Wakefield'; 'The Deserted Village'.
Sir Edmund Gosse (1849–1928), poet and critic—'Father and Son'; 'History of Modern English Literature'.
John Gower (1325?–1408), poet—'Confessio Amantis'.
Kenneth Grahame (1859–1932), writer of children's stories —'The Golden Age'; 'The Wind in the Willows'.
Robert R. Graves (1895–), poet and critic—'Good-Bye to All That'; 'Fairies and Fusiliers'.
Thomas Gray (1716–1771), poet—'Elegy in a Country Churchyard'; 'The Progress of Poesy'.
Robert Greene (1560?–1592), poet and dramatist—'Sweet are the Thoughts'; 'Sephestia's Song to Her Child'.
Thomas Hardy (1840–1928), novelist and poet—'Far from the Madding Crowd'; 'The Return of the Native'; 'Tess of the D'Urbervilles'; 'Wessex Poems'.
Stephen Hawes (1475–1530), poet—'Example of Virtue'.
William Hazlitt (1778–1830), essayist and critic—'Table Talk'; 'Characters of Shakespeare's Plays'.
William E. Henley (1849–1903), poet, critic, and dramatist—'London Voluntaries'; 'Hospital Sketches'.
George Herbert (1593–1633), poet—'The Temple'.
Robert Herrick (1591–1674), poet—'Hesperides'.
Maurice Hewlett (1861–1923), novelist and poet—'Richard Yea-and-Nay'; 'The Queen's Quair'; 'The Forest Lovers'.
Thomas Hobbes (1588–1679), philosopher—'The Leviathan'.
Ralph Hodgson (1871–), poet—'The Last Blackbird'.
Richard Hooker (1553–1600), theologian—'Laws of Ecclesiastical Polity'.
Thomas Hood (1798–1845), poet and humorist—'The Song of the Shirt'; 'Miss Kilmansegg'.
Anthony Hope (1863–1933), novelist—'The Prisoner of Zenda'; 'Rupert of Hentzau'.
Alfred E. Housman (1859–1936), poet—'A Shropshire Lad'.
Laurence Housman (1865–), poet and dramatist—'Green Arras'; 'Spikenard'.
William H. Hudson (1841–1922), naturalist and romancer—'The Purple Land'; 'Far Away and Long Ago'; 'Green Mansions'; 'A Hind in Richmond Park'.
David Hume (1711–1776), philosopher and historian—'Inquiry Concerning Human Understanding'.
Leigh Hunt (1784–1859), essayist and poet—'Abou Ben Adhem'; 'The Story of Rimini'; 'Autobiography'.
A. S. M. Hutchinson (1879–), novelist—'If Winter Comes'; 'The Happy Warrior'; 'This Freedom'.
Aldous Huxley (1894–), poet and novelist—'Chrome Yellow'; 'Antic Hay'; 'Point Counterpoint'.
James I of Scotland (1394–1437), poet—'The Kingis Quair'.
Jerome K. Jerome (1859–1927), humorist and dramatist—'Idle Thoughts of an Idle Fellow'; 'Three Men in a Boat'.
Samuel Johnson (1709–1784), essayist and lexicographer—'A Dictionary of the English Language'; 'Rasselas'.
Ben Jonson (1573?–1637), poet and dramatist—'Song to Celia'; 'Drink to Me Only with Thine Eyes'.
James Joyce (1882–1941). poet and novelist—'Portrait of the Artist as a Young Man'; 'Dubliners'; 'Ulysses'.
Sheila Kaye-Smith (? –), novelist—'Joanna Godden'.
John Keats (1795–1821), poet—'The Eve of St. Agnes'; 'Ode on a Grecian Urn'; 'Endymion'.
Margaret Kennedy (1896–), novelist—'The Constant Nymph'; 'The Ladies of Lyndon'; 'Return I Dare Not'.
Charles Kingsley (1819–1875), novelist—'Westward Ho'; 'Water Babies'; 'Hypatia'.
Rudyard Kipling (1865–1936), novelist, poet, and short story writer—'Kim'; 'Barrack Room Ballads'; 'Puck of Pook's Hill'; 'Just So Stories'; 'The Jungle Book'.
Charles Lamb (1775–1834), poet and essayist—'Essays of Elia'; 'Tales from Shakespeare' (with Mary Lamb).
Walter Savage Landor (1775–1864), poet and prose writer—'Imaginary Conversations'; 'Hellenics'.
Andrew Lang (1844–1912), poet and prose writer—'Ballads in Blue China'; 'Blue', 'Red', and other fairy books.
William Langland (1330?–1400?), poet—'Vision of Piers Plowman'.
David Herbert Lawrence (1885–1930), poet, novelist, and essayist—'Sons and Lovers'; 'Sea and Sardinia'.
Layamon (about 1200), metrical historian—'Brut'.
John Locke (1632–1704), philosopher—'Essay Concerning Human Understanding'; 'Of Civil Government'.
William J. Locke (1863–1930), novelist—'The Beloved Vagabond'; 'Joyous Adventures of Aristide Pujol'.
Thomas Lodge (1558?–1625), poet and romancer—'Rosalynde'.
Richard Lovelace (1618–1658), poet—'To Althea, from Prison'.
Edward Verrall Lucas (1868–1938), essayist, novelist, and biographer—'London Lavender'; 'Life of Charles Lamb'.
Edward Bulwer-Lytton (1803–1873), novelist—'Last Days of Pompeii'; 'Harold, the Last of the Saxon Kings'.
John Lydgate (1373?–1450?), poet—'Troy Book'.
John Lyly (1553?–1606), novelist and dramatist—'Euphues: The Anatomy of Wit'; 'Euphues and his England'.
Rose Macaulay (? –), novelist—'Orphan Island'.
Thomas Babington Macaulay (1800–1859), historian, poet, and essayist—'History of England'; 'Lays of Ancient Rome'.
George Macdonald (1824–1905), novelist, poet, and children's writer—'David Elginbrod'; 'Robert Falconer'; 'The Princess and the Goblin'.
Sir Thomas Malory (died 1470?), translator—'Morte d'Arthur'.
Katherine Mansfield (1890–1923), short story writer—'The Garden Party'; 'Bliss'; 'The Dove's Nest'.
Archibald Marshall (1866–1934), novelist—'The Eldest Son'; 'Abingdon Abbey'; 'Exton Manor'.
John Masefield (1878–), poet, novelist, and dramatist—'Salt-Water Ballads'; 'The Daffodil Fields'; 'Sard Harker'.
W. Somerset Maugham (1874–), novelist, short story writer, and dramatist—'Of Human Bondage'; 'The Moon and Sixpence'; 'Cakes and Ale'; 'The Trembling of a Leaf'.
George Meredith (1828–1909), novelist and poet—'The Egoist'; 'The Ordeal of Richard Feverel'; 'Diana of the Crossways'; 'Evan Harrington'; 'Modern Love'.

Leonard Merrick (1864–1939), novelist and short story writer—'Conrad in Quest of His Youth'; 'The Little Dog Laughed'.
Alice Meynell (1850–1922), poet and essayist—'Preludes'; 'Renouncement'; 'The Rhythm of Life'.
John Stuart Mill (1806–1873), philosopher and economist—'Principles of Political Economy'; 'Autobiography'.
A. A. Milne (1882–), novelist, essayist, and children's writer—'When We Were Very Young'; 'Two People'.
John Milton (1608–1674), poet—'Paradise Lost'; 'L'Allegro'; 'Il Penseroso'; 'Lycidas'; 'Samson Agonistes'.
Charles E. Montague (1867–1928), novelist and critic—'A Hind Let Loose'; 'Right Off the Map'; 'Dramatic Values'.
George Moore (1852–1933), novelist—'Esther Waters'; 'Héloïse and Abélard'; 'Confessions of a Young Man'.
Sir Thomas More (1478–1535), prose writer—'Utopia'.
William Morris (1834–1896), poet—'The Defence of Guenevere'; 'The Earthly Paradise.
John Henry Newman (1801–1890), theologian and essayist—'Idea of a University'; 'Apologia pro Vita Sua'.
Robert Nichols (1893–), poet—'Ardours and Endurances'; 'Under the Yew'; 'Aurelia'.
Alfred Noyes (1880–), poet—'Tales of the Mermaid Tavern'; 'The Wine Press'; 'Drake, an English Epic'.
Walter Pater (1839–1894), essayist—'Imaginary Portraits'; 'Marius the Epicurean'; 'The Renaissance'.
Samuel Pepys (1633–1703), diarist—'Diary'.
Alexander Pope (1688–1744), poet and translator—'Rape of the Lock'; 'Windsor Forest'; 'Essay on Criticism'; 'Essay on Man'; 'Iliad' and 'Odyssey' (*trans.*).
John Cowper Powys (1872–), novelist and critic—'Visions and Revisions'; 'The Meaning of Culture'.
Llewelyn Powys (1884–1939), prose writer—'Black Laughter'.
Bryan Waller Procter ("Barry Cornwall") (1787–1874), poet—'Dramatic Scenes and Other Poems'.
Sir Arthur Quiller-Couch (1863–), poet, critic, and novelist—'On the Art of Reading'; 'On the Art of Writing'.
Ann Radcliffe (1764–1823), novelist—'The Romance of the Forest'; 'The Mysteries of Udolpho'.
Charles Reade (1814–1884), novelist—'The Cloister and the Hearth'; 'It's Never Too Late to Mend'; 'Foul Play'.
Samuel Richardson (1689–1761), novelist—'Pamela, or Virtue Rewarded'; 'Clarissa, or the History of a Young Lady'.
Christina Rossetti (1830–1894), poet—'Sing-Song'; 'Goblin Market'.
Dante Gabriel Rossetti (1828–1882), poet—'The Blessed Damozel'; 'The House of Life'.
John Ruskin (1819–1900), art critic and essayist—'Modern Painters'; 'The Seven Lamps of Architecture'; 'Sesame and Lilies'.
George William Russell ("Æ") (1867–1935), poet and essayist—'Homeward'; 'Gods of War'; 'The Interpreters'; 'The National Being'.
George Saintsbury (1845–1933), literary critic and historian—'A History of Criticism'; 'Nineteenth Century Literature'.
George Santayana (1863–), philosopher and poet—'The Life of Reason'; 'The Sense of Beauty'.
Siegfried Sassoon (1886–), poet and novelist—'Counter-Attack'; 'Memoirs of a Fox-Hunting Man'.
Sir Walter Scott (1771–1832), poet and novelist—'The Lady of the Lake'; 'Waverley'; 'Ivanhoe'; 'Kenilworth'.
William Shakespeare (1564–1616), dramatist and poet—'Sonnets'.
George Bernard Shaw (1856–), dramatist and essayist—'The Intelligent Woman's Guide to Socialism and Capitalism'; critical prefatory essays to various plays.
Percy Bysshe Shelley (1792–1822), poet—'Ode to the West Wind'; 'Prometheus Unbound'; 'To a Skylark'; 'Adonais'.
Ethel Sidgwick (1877–), novelist and playwright—'Promise'; 'Le Gentleman'; 'Lady of Leisure'.
Sir Philip Sidney (1554–1586), poet—'Astrophel and Stella'; 'Arcadia'.
May Sinclair (? –), novelist—'The Divine Fire'.
Adam Smith (1723–1790), economist—'The Wealth of Nations'.
Tobias Smollett (1721–1771), novelist—'Roderick Random'; 'Humphrey Clinker'.
Robert Southey (1774–1843), poet and historian—'Battle of Blenheim'; 'Life of Nelson'.
Edmund Spenser (1552?–1599), poet—'Faerie Queene'.
Flora Annie Steel (1847–1929), novelist—'On the Face of the Waters'; 'In the Permanent Way'; 'The Curse of Eve'.
Richard Steele (1672–1729), essayist and dramatist—Essays in *The Spectator* and *The Tatler*.
James Stephens (1882–), poet, short story writer, and novelist—'The Hill of Visions'; 'Songs from the Clay'; 'The Crock of Gold'; 'Etched in Moonlight'.
Laurence Sterne (1713–1768), novelist—'Tristram Shandy'; 'A Sentimental Journey'.
Robert Louis Stevenson (1850–1894), novelist, essayist, and poet—'Treasure Island'; 'Kidnapped'; 'Travels With a Donkey'; 'A Child's Garden of Verses'.
G. Lytton Strachey (1880–1932), biographer—'Eminent Victorians'; 'Queen Victoria'; 'Elizabeth and Essex'.
Sir John Suckling (1609–1642), poet—'Ballad upon a Wedding'.
Jonathan Swift (1667–1745), satirist—'Gulliver's Travels'; 'Tale of a Tub'; 'Journal to Stella'.
Algernon Charles Swinburne (1837–1909), poet—'Atalanta in Calydon'; 'Songs before Sunrise'; 'Poems and Ballads'.
Frank A. Swinnerton (1884–), novelist—'Nocturne'.
John Addington Symonds (1840–1893), critic—'History of the Renaissance in Italy'.
Ann (1782–1866) and Jane (1783–1824) Taylor, writers for children—'Rhymes for the Nursery' (containing 'Twinkle, Twinkle, Little Star').
Alfred, Lord Tennyson (1809–1892), poet—'Idylls of the King'; 'In Memoriam'; 'Locksley Hall'.
William Makepeace Thackeray (1811–1863), novelist—'Vanity Fair'; 'Henry Esmond'; 'The Newcomes'.
Francis Thompson (1859–1907), poet—'The Hound of Heaven'.
James Thomson (1700–1748), poet—'The Seasons'; 'The Castle of Indolence'; 'Rule, Britannia'.
James Thomson ("B.V.") (1834–1882), poet—'The City of Dreadful Night'; 'Vane's Story'.
H. M. Tomlinson (1873–), essayist and novelist—'Old Junk'; 'Gallions Reach'; 'All Our Yesterdays'.
Anthony Trollope (1815–1882), novelist—'Barchester Towers'; 'Framley Parsonage'; 'Doctor Thorne'.
William Tyndale (1492?–1536), translator and tract writer—The New Testament (*trans.*).
Henry Vaughan (1622–1695), poet—'The Retreat'.
Horace Walpole (1717–1797), novelist and letter writer—'Castle of Otranto'; 'Letters'; 'Memoirs'.
Hugh Walpole (1884–1941), novelist—'Fortitude'; 'Jeremy'.
Izaak Walton (1593–1683), essayist and biographer—'The Compleat Angler'; 'Lives'.
Herbert G. Wells (1866–), novelist and historian—'Tono-Bungay'; 'The Time Machine'; 'Mr. Britling Sees It Through'; 'Outline of History'.
Rebecca West (1892–), novelist, essayist, and critic—'The Judge'; 'Harriet Hume'; 'The Return of the Soldier'.
Oscar Wilde (1856–1900), poet, novelist, dramatist—'The Ballad of Reading Gaol'; 'The Picture of Dorian Gray'.
Virginia Woolf (1882–1941), novelist and critic—'Mrs. Dalloway'; 'To the Lighthouse'; 'Orlando'; 'The Waves'.
William Wordsworth (1770–1850), poet—'Tintern Abbey'; 'Intimations of Immortality'; 'The Prelude'.
Sir Thomas Wyat (1503–1542), poet—sonnets and lyrics.
William Butler Yeats (1865–1939), poet, essayist, dramatist—'The Wild Swans of Coole'; 'Ideas of Good and Evil'.
Charlotte M. Yonge (1823–1901), novelist—'The Dove in the Eagle's Nest'; 'Unknown to History'.
Francis Brett Young (1884–), novelist—'Woodsmoke'; 'The Dark Tower'; 'Sea Horses'.
Israel Zangwill (1864–1926), novelist and dramatist—'Children of the Ghetto'; 'Dreamers of the Ghetto'.

PICTURES *for* ALL *Through the* ENGRAVER'S ART



Albrecht Dürer was one of the masters of engraving on wood and etching on copper. This print, 'The Holy Anthony', is one of his finest engravings; like most of his work, it is signed with his monogram. The picturesque city is Nuremberg.

ENGRAVING AND ETCHING. Have you ever walked past a print in the school library, or in some art gallery, and asked yourself how that print was made? Have you often wondered how it was possible to reproduce the artist's original design so faithfully?

All prints, or printed pictures, are made in one of two ways: first, they may be printed directly from a plate or block or stone in which the artist has himself cut or worked the design; second, they may be made by some method in which mechanical processes are substituted for the hands of the artist. Some artists make a sketch on paper before they start work on the plate, but many draw directly on the plate.

As the artist works on the plate he pulls proofs from time to time to see how the picture is progressing. Some of these proofs will be rough working proofs, not worth saving. But soon the design will be far enough advanced so that the proofs are artistically significant; then the artist may pull a number of "artist's proofs" and even sign his name on the margin of the print. If the artist pulls a number of proofs at one time, at a recognizable stage in the development of the picture, he has established a "state." These are called "first state," "second state," and so on, as changes are made to improve or repair the plate. Formerly it was the practise for an artist to sell proofs of various states—the earlier states, with the finest lines and most delicate shading, being the most desirable. In commercial practise today, an artist seldom disposes of any proofs until his work is finished; then he prints an "edition," which may be as small as 10 or as many as 150, depending on the demand; such an edition is called the "published state."

No matter whether the plate is made by the artist himself, or is reproduced by a photomechanical process, every "print" is the result of a printing process, that is, the printing surface is covered with ink, and an impression is made on paper, vellum, or other suitable material. A plate is made by one of three processes: relief, intaglio, plane or surface.

In *relief* plates the spaces which show white are cut away, leaving the design on the face of the plate to catch the ink.

In *intaglio* plates the design which is to be printed is cut into the plate, and the ink must be forced carefully into every depression or part of the design. The surface of the plate, which is to show white, is then wiped clean, leaving ink only in the incised design.

In *plane* or *surface* prints, the design to be printed and the white spaces are on the same surface. The plate is treated chemically so that the design holds

the ink while the white spaces will not retain the ink but repel it (*see* Lithography).

The material on which the picture has been worked has nothing to do with this grouping. Roughly grouped, woodcuts constitute the first class, relief prints; engravings and etchings on copper, the second class, intaglio; and lithographs the third class. But metal and linoleum have sometimes been used for relief prints in place of wood; zinc, steel, wood, and linoleum in place of copper for intaglio; and zinc, aluminum, and glass in place of stone for plane prints.

Wood Engraving, the Oldest Relief Process

Engraving in relief is usually done on a block of hard wood, preferably cherry or boxwood, cut lengthwise like a plank and about an inch thick. On this block the artist draws his design. If he is copying an existing design he must be careful to reverse it; he can do this easily by making a tracing of the design and placing the tracing face down on the block. If the drawing is slightly dampened, and the back carefully rubbed with a paper knife, the design will appear correctly on the wood block. The artist himself or a special woodcutter cuts away all the space left between the lines of the design. Where the spaces are large he will cut deep; where they are small, as in shading, he will not cut more than one-sixteenth of an inch. This method is called black-line work, because the printing is done by the lines left outstanding, the cut out spaces not taking the ink.

Chiaroscuro woodcuts, done in surfaces instead of lines, are really a variation of black-line engraving, the only difference being that flat surfaces instead of simple lines are left standing in relief. As early as the 16th century chiaroscuro blocks were used especially in Germany and Italy when the artist wished to apply two colors or tints, each impression being made directly on top of the other. Chiaroscuro is a transitional method between black-line and white-line engraving.

In white-line engraving the design is cut into the wood. Instead of using knives of various shapes on a plank, the woodcutter takes a block which is sawed across the grain, in which he makes a pattern of dots and lines by means of a "graver," a tool resembling a chisel. In white-line engraving it is possible to produce various tints or shades. This method is a distinct advance over the old wood blocks, which were mostly just solid blacks and whites, without intermediate tints. When the block is ready to print, it is inked by a soft roller, which will spread the ink on the surface but not press it into the white spaces.

The earliest woodcut probably dates from before 1400, but the first dated one known, a Virgin Mary probably of German origin, carries the date 1418. Woodcuts were first used as a substitute for the costly hand miniatures with which medieval manuscripts were decorated (*see* Books and Bookmaking).

In the early history of wood engraving the greatest names are Dürer and Holbein (*see* Dürer, Albrecht; Holbein, Hans). Dürer first made wood engraving a fine art. He recognized the possibilities of a process which used lines instead of tones, and he made a virtue of what his predecessors regarded as a defect. Holbein used few lines, but each line had vital force and directness. His 'Dance of Death', and the illustrations for the Old Testament are among the outstanding achievements of modern art. After the 16th century the great artists generally abandoned the use of the woodcut for other kinds of engraving, but in the 18th century Thomas Bewick gave the art a new impulse. Most of Bewick's work is white-line engraving. About the same time an American, Alexander Anderson, was imitating Bewick's style with a skill which placed him second only to that master himself. Of recent Americans the best are Timothy Cole, famous for his accurate reproductions of paintings, Rudolph Ruzicka, who combines delicacy of line with broad masses which are solid but not heavy, and Rockwell Kent, a prolific worker with a strong individual style based on vivid contrasts between blacks and whites and a strong feeling for light.

The Intaglio Processes

Intaglio processes are numerous and complicated. The simplest of them is line or burin engraving. Line engraving was discovered probably between 1410 and 1430 by German or Flemish goldsmiths, and it was practised in Italy by 1460. After the smith had decorated a piece of gold or silver plate with an engraved design, he would often fill the lines with black enamel to make the pattern more conspicuous. In Italian this was called *niello*, or black work. It was customary, in order to judge the design, to take a "rubbing" or print from the plate before filling the lines with enamel.

The line engraver uses a graver called a "burin," which gouges a V-shaped line. The engraver bears lightly on the burin until he is sure of his design; again as he approaches the end of the line, he lessens the pressure. Thus, the deeper middle portions hold more ink than the shallower finer ends. The raised line of a woodcut, on the contrary, is inked equally from end to end. As the burin is pushed forward, it leaves a ridge or "burr" of fine shavings at the sides. As these would hold the ink during the printing, they are removed by a scraper which leaves the edges clean.

Line engravings are usually made on copper, for it is hard enough to stand pressure in printing and soft enough to yield easily to the graver. For a plate as large as a page of this book the copper should be about an eighth of an inch thick. Gold, silver, brass, pewter, zinc, and steel may also be used, but only the last two have been of commercial importance. As a pencil or crayon mark does not show plainly on the polished surface of the metal, the surface of the plate is usually varnished before the engraver starts his work. As with woodcuts the artist may draw his design directly on the plate, or he may transfer it from a preliminary paper sketch. When the drawing is ready, on the plate, the artist cuts away the lines with the burin. The furrows made by the burin are very shallow, and even the slightest scratch will print.

"Steel engravings," on steel plates, are usually produced by etching, but the graver also is used. The chief advantage of this process, which is employed mostly in printing stamps, paper money, and bonds, lies in the larger number of prints that can be made from the harder metal, and in its clean, sharp outlines.

The printing of an engraving is more difficult than that of a woodcut. Great care must be used in getting the ink into every part of the design, and then in wiping clean the rest of the plate. The ink is rather thick, or "stiff," and to soften it both the ink and the plate are heated slightly before printing. The special press for printing engravings operates like a clothes wringer. Above the plate, and almost touching it, is a horizontal cylinder. The bed of the press, on which the plate is laid face up, runs on rollers. By turning a crank the printer forces the bed and the cylinder in opposite directions, thus exerting great pressure. This pressure causes the edges of the plate to leave a mark on the paper, called the plate mark.

The honor roll of master engravers begins in 15th-century Italy with Mantegna, and in 16th-century Germany with Dürer and Holbein. Mantegna is distinguished for the strength and sharpness of his burin-cut lines and for his classical subjects. Dürer had a genius for detail, exemplified by his 'Melancholy', which is regarded by many as the finest engraved print in existence. The classical period of line engraving came in the time of Louis XIV. At his court arose a school of portrait engravers, of whom Nanteuil, Masson, Edelinck, and Pierre Drevet were foremost, who combined great skill in rendering character with a marvelous technical proficiency in reproducing the texture of hair, fur, silks, armor, and other materials.

A GREAT GENERAL, BY A GREAT ENGRAVER

Robert Nanteuil, who engraved this beautiful portrait of Turenne, marshal of France, was the foremost of the 17th-century line engravers in France and one of the greatest engravers of all time. Note the exquisite texture of the hair and the sheen of the armor.

How the Etcher Works

The word etching comes from the Dutch *etzen* (to eat). An etching is really an engraving in which the design on the metal plate, usually copper, is eaten away by an acid. First of all the etcher covers the plate, carefully smoothed and polished, just like one for a line engraving, with a "ground," which is a compound of beeswax and other substances. When the ground is hard it will resist acid. The dry ground is still transparent, and is usually smoked over a candle or gas flame so that the design will be easily seen. On this black surface the etcher lightly pencils the picture. Then he takes his etching needle, which is like an ordinary sewing needle, but set in a wooden handle, and cuts away the ground along the lines of the picture, but not the metal itself. When the complete design shows against the black ground the plate is ready to be etched.

Etching is done by immersing the plate in a shallow dish or tray filled with a *mordant* (from the French "to bite"). For this purpose various acids are used, preferably a solution of nitric or of hydrochloric acid. The acid slowly eats away the copper in the lines, thus saving the artist the trouble of gouging out the metal. When the artist is satisfied that the biting has gone far enough, he rinses the plate in clear water, dries it, and removes the etching ground with turpentine. Printing an etching is done in the same manner as a line engraving, but much more depends on the skill and taste of the printer. He may leave a little ink on parts of the plate not etched, or he may rub one section of the plate cleaner than the rest, thus heightening the effect. Ink deliberately left on the plate in this way and not a part of the design is called "retroussage."

The earliest known etching was made on iron, in 1513, by a Swiss artist, Urs Graf, and within the next 15 years the practise of etching became common. Among early etchers the great names are Albrecht Dürer, Jacob Ruysdael, Jacques Callot, Claude Lorrain, Sir Anthony Van Dyck, Guido Reni, José Ribera, and Salvator Rosa. Generally considered greatest of all etchers is Rembrandt (*see* Rembrandt). Whether we consider his landscapes, like the famous 'Three Trees', his dramatic representations, like 'Christ Healing the Sick', or the numerous portraits of rich and poor, old and young, "all alike are illuminated by a power which never fails to pierce to the heart of things."

Among later etchers one of the greatest names is the Spaniard, Francisco Goya. His series of etchings on 'Disasters of War' and on bull-fighting ('Tauromaquia') are famous for their satirical spirit no less than for their technical brilliance. Charles Méryon and Anders Zorn stand in the first rank of etchers of all time. Méryon was color blind, and unlike most etchers, could not paint in oils or water-colors. He worked over most of his plates in many states, sometimes seven or eight, until he finally realized the

perfection of design for which he was seeking. Theodore Rousseau, Charles Jacque, C. F. Daubigny, and J. F. Millet, all painters of the Barbizon school, also etched. First among modern English etchers are F. Seymour Haden, David Y. Cameron, Muirhead Bone, William Strang, Frank Brangwyn; and among the younger men James McBey, Henry Rushbury, and F. L. Griggs. Alphonse Legros, a Frenchman, and James McNeill Whistler, an American, spent the greater part of their lives in England, and their influence undoubtedly fixed the style of English etching for their generation. Other American etchers whose work is sought by collectors are Stephen Parrish, Joseph Pennell, Donald S. MacLaughlan, Frank W. Benson, Arthur Heintzelman, Louis C. Rosenberg, and Samuel Chamberlain.

In dry-point etching no etching ground or acid is used; the line is cut directly into the metal by a metal needle (sometimes tipped with a diamond or a ruby) drawn toward the artist. As it plows the metal, it leaves a "burr" of curled shavings on each side of the line. In line engraving this burr is scraped away, but the distinctively beautiful effects of dry-point are the results of allowing the burr to remain. When inked, it imparts warm, velvety lines to the impression. Since the burr is delicate and easily worn down, the first impressions are the best.

Mezzotints and Aquatints

In mezzotint engraving the metal surface is first covered with small depressions evenly distributed. This is done with an instrument called a "rocker," a curved piece of metal with projecting points, which is rocked across the plate until the entire surface is roughened. Then the artist scrapes his design on the plate with a scraper, a blunt piece of metal, so that in places the depressions become shallower or disappear entirely. In the latter case, as there is nothing to hold ink, the paper will remain white; and as the depressions are left deep or shallow, they will hold more or less ink, printing darker or lighter. A design can thus be worked out which will print every gradation of light and shade from black to white.

The 18th century witnessed the triumph of mezzotint in England at the hands of a remarkable group of engravers who devoted their talents to reproducing the portraits of Gainsborough, Sir Joshua Reynolds, and others. The art of landscape engraving found its finest expression in Turner in a combination of etching with mezzotint (*see* Turner, Joseph M. W.).

Aquatint and stipple were much used in the 18th and early 19th centuries, but are now rarely practised. Aquatinting was popular for reproductions of watercolors, and for original landscapes, while stipple had its greatest popularity for portraits. In aquatinting the plate is first covered with a special ground, and is then lightly etched all over, to produce a uniform background. After the design has been drawn on or transferred to the plate, the artist uses a brush to "stop out" parts of the plate. The use of a brush eliminates the possibility of gradations or shadings, as the sweep of the brush defines a distinct space. Aquatint is often used in combination with other etching processes. In stippling, after the plate is covered with an etching ground, the design is "picked out" in dots with needles of various sizes and shapes. The darker portions of the design are made by larger dots. These dots are then bitten into the copper by an acid. Delicate gradations in light and shade are possible in this method.

How to Appreciate Prints

Taste in art is not inborn; it is the product of study and knowledge. When you study prints you must realize, first of all, the limitations of the method used. The engraver and etcher work in lines, usually without colors. These lines may be irregular and even broken into dots, but they are not solid masses. Line is something which the artist must create, because nature does not offer him a model to copy. The great etching is not photographic, but suggestive.

If the print is before you it is not hard to tell whether it was done by relief, intaglio, or plane printing. A relief print, usually a woodcut, has no plate mark, whereas an intaglio print has one clear and sharp. In a lithograph the plate mark is often very slight, but you can see it by holding the print horizontally with the eye; although there may be no apparent ridge of paper at the edge of the plate, the paper will appear pressed smooth where the stone or plate has covered it.

Another way to test a print is to feel the paper. If the ink stands out like the lettering on an engraved visiting card, you may be sure that an engraved plate was used. If the ink seems to be flat on the paper, the print must be either a woodcut or a lithograph. Sometimes these are hard to distinguish, but usually ink used on woodcuts has a dry appearance, while lithographic ink looks more or less grayish.

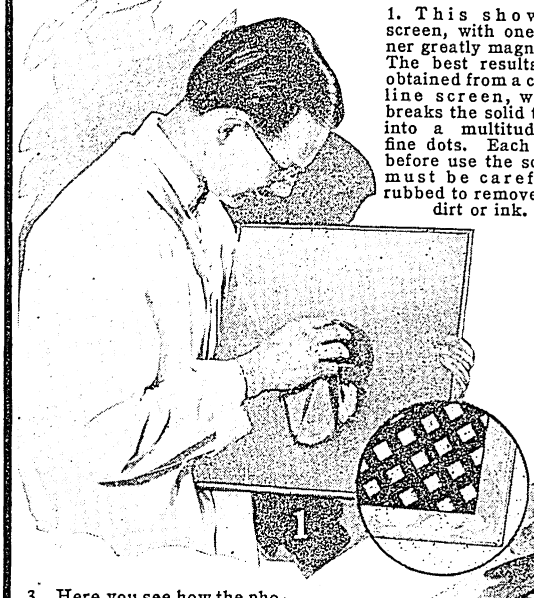
The best test of a print is the character of the lines. If these are firm and regular, many of them parallel, it is probably an engraving, for the burin must move regularly and under great pressure to make lines in the metal plate. On the other hand if the lines look free, perhaps as if they had been done in a hurry, it is an etching. Generally a woodcut line is simpler and broader in effect than an engraved line, and its edges are too clean to cause confusion with an etched line. A print which appears to be composed of little dots is probably a stipple. Aquatints appear flat, with only a few degrees in tone or shade, and each of these is separate and does not run into the others. In mezzotint the tone is rich and velvety, with delicate gradations from light to dark. When the artist has combined two or more methods in one plate it is sometimes hard to decide which were used, but with a little practise in handling actual prints you will see that each process has a distinctive quality.

Photomechanical Processes

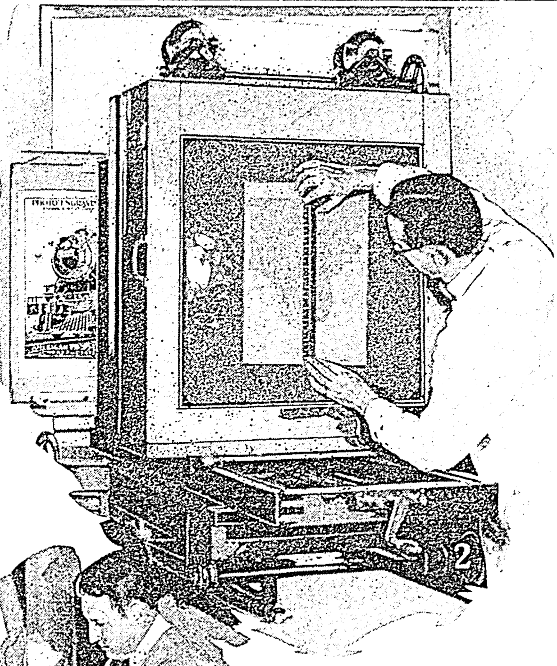
The photomechanical processes, by which our newspapers, magazines, and books are illustrated, use the basic principles of both photography and engraving.

HOW THE HALF-TONES IN THIS BOOK WERE MADE

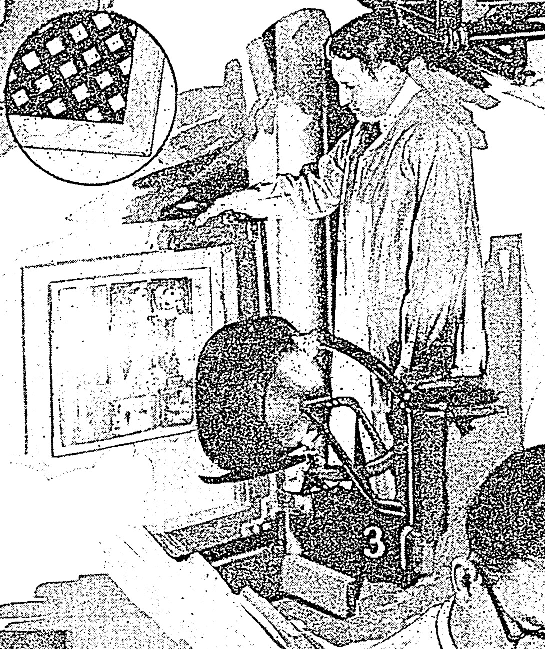
Half-tones are made by photographing an object or picture through a screen, and then transferring to a metal plate the photographic image which is obtained on the negative. The metal plate becomes the half-tone. The screen is made of two pieces of glass, cemented together after each plate has been ruled and the ruled lines filled with a black opaque substance. The screens used for half-tones in this book have 120 lines to the inch. Newspaper half-tones usually have 60 to 80 lines.



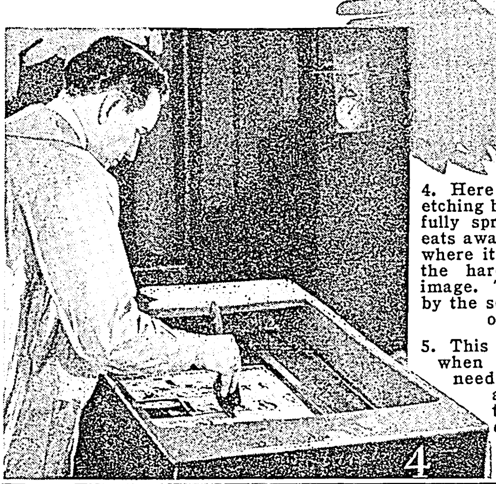
1. This shows a screen, with one corner greatly magnified. The best results are obtained from a cross-line screen, which breaks the solid tones into a multitude of fine dots. Each time before use the screen must be carefully rubbed to remove any dirt or ink.



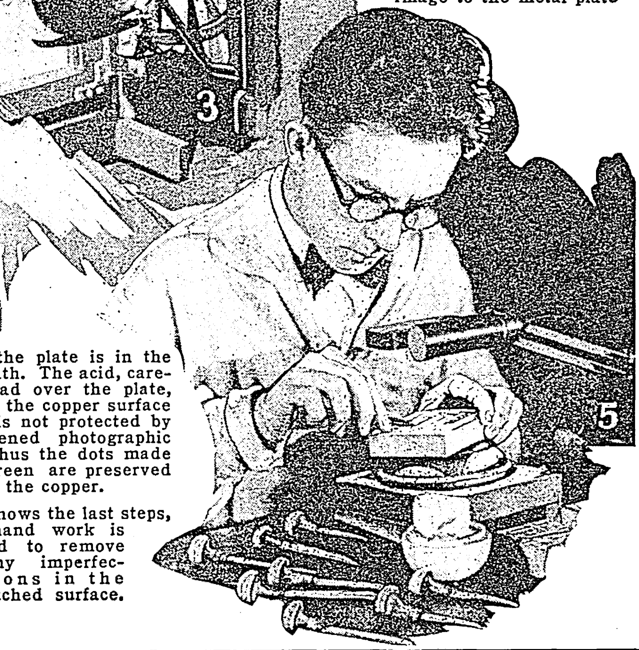
2. Here you see the copy in place before the camera, and the inverted image in the back of the camera. By turning the handle the photographer moves the camera forward or backward, until the image is exactly the required size. The negative, which is developed like any photographic negative, will show dots of varying sizes, the larger dots being the darker parts of the picture. The next step is to transfer the image to the metal plate



3. Here you see how the photographic image is transferred to the metal. The negative is placed in contact with a copper plate, which has been coated with a sensitized preparation of fish glue, bichromate of ammonia and albumen. A powerful light is then turned on the negative and the plate. Where the light strikes the copper through the negative, the sensitized coating becomes hardened; where light does not strike, because the lines made by the screen interfere, the coating may be washed off in water. After the image is produced on the copper, it is carbonized or "fixed" by heating over a gas flame. It is then ready for etching.



4. Here the plate is in the etching bath. The acid, carefully spread over the plate, eats away the copper surface where it is not protected by the hardened photographic image. Thus the dots made by the screen are preserved on the copper.

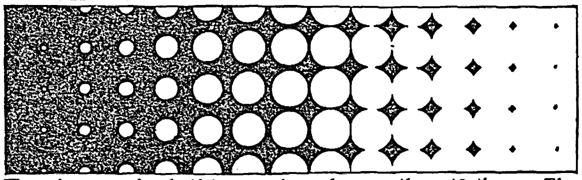


5. This shows the last steps, when hand work is needed to remove any imperfections in the etched surface.

The commonest process by which a design is transferred to a printing plate in relief is the half-tone, first used commercially about 1880. In this process an object or a picture is photographed through a screen which breaks up the tones into a multitude of fine dots. The photographic image is then transferred to a copper plate, which is etched as described on page 297, so the dots become the printing surface.

Although the half-tone process is best for reproducing photographs and solid objects, zinc etching is the most satisfactory way of reproducing black- and white-line drawings. In this process no screen is used in transferring a design by photography to a sensitized zinc plate. The parts of the plate which correspond to the original design are hardened as solid lines or masses. After the soluble portions are washed away, the lines are strengthened with a chemical compound

THE SECRET OF THE HALF-TONE



Here is part of a half-tone enlarged more than 40 times. The black portions are the parts of the copper which will receive the ink and transfer it to the printed page. The white portions are the etched hollows or valleys between, which catch no ink and leave the paper white. By this variation of density all shades from almost pure black to almost pure white are produced.

called "dragon's blood." The plate is then etched in a solution of nitric acid, withdrawn for the application of more dragon's blood, and etched again.

The Ben Day process for adding special effects to zinc etchings employs a mechanical shading machine. The machine has a film or screen of thin, transparent, gelatin-like substance, with the Ben Day pattern engraved on the under side. The screen is stretched in a metal frame, and the pattern side inked and transferred, sometimes to the drawing itself, but usually to a zinc plate or to a negative. More than 100 patterns are available for Ben Day work—stipple, grain, stripes, tints, lines, texture effects, and many others.

Photogravure is an intaglio or depressed surface process. A film of sensitized gelatin is flowed on a grained copper plate or cylinder, and is exposed under a photographic positive. Sometimes the gelatin is backed with paper, exposed to the positive and then transferred to the plate; the film of gelatin, bearing the reproduction, adheres to the copper, and the paper is then washed off. Next the copper is placed in a ferric (iron) chloride solution, which penetrates the film and eats millions of tiny depressions into the metal, etching deeper or shallower, according to the thickness of the gelatin film. With this process there is an absence of sharp lines and dots; this results in a richness of texture not obtainable in half-tones.

For "rotogravure" printing the etching is done on a copper cylinder with a screened ground. In printing, the cylinder revolves in a trough of greasy ink. When the plate leaves its inky bath, a sharp knife scrapes away all the ink except that held in the depressions. Rotogravure is specially suitable for newspapers and magazines.

Of recent years photolithography, also known as "offset" and "planograph" printing, has become one of the most important branches of commercial printing. Zinc or aluminum plates, specially treated, take the place of the old lithographing stones. The plates are covered with a solution similar to that used to sensitize plates in other photomechanical processes and after exposure the lines and dots of the transferred design are covered with printing ink and the rest of the plate is treated to repel the ink during the printing process. (*See* Lithography.)

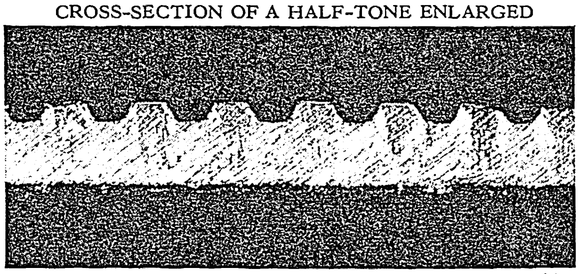
Printing in Colors

Woodcuts in colors were used by a few printers in the 15th century, but these were mostly initial letters or decorative borders, not colored prints as we think of them today. Color was not successfully applied to intaglio plates until two centuries later. At first all coloring was done on one plate, and the plate re-inked for each print. Except for the inking, color printing of this kind used no processes different from those already described.

The second method of printing in colors is to make a plate for each color, and print the plates consecutively. The plates must all be the same size, and great care must be used to insure perfect register. This type of color printing reached its peak in the 18th century at the hands of Janinet and Debucourt, who sometimes used as many as seven or eight plates for their elaborate prints. Modern color printing reduces all colors to three components, yellow, blue, and red. The first man to apply this principle to color printing was J. C. LeBlon, about 1720.

By photographing through colored glasses or "light filters," only the portions in red appear on one negative, the yellow on another, the blue on the third.

CROSS-SECTION OF A HALF-TONE ENLARGED



This is a view of a half-tone when cut in two and looked at sideways under the microscope. The saw-tooth projections are the dots which print black, and thus give the shading shown in the other picture on this page.

A separate plate is made from each negative. When the impressions from these plates are printed one over another in the proper colors, the result is a blend of colors in reproduction of the original.

EN'ZYMES. These chemical substances are formed in living plant or animal cells, and they play an important part in growth, digestion, and other life processes. An unripe apple is very different in taste

from one that has been ripened; enzymes have brought about the change. Bananas are gathered green and shipped to points where they do not grow; the enzymes convert the hard woody pulp into delicious food. The action of yeast and bacteria is due largely to the enzymes they produce (*see* Bacteria; Yeast).

But what are these chemical kings of the plant and animal world? In the Chemistry article you may read about catalysts, substances that promote the formation of chemical compounds without entering into them. Platinum, for instance, promotes the union of oxygen and hydrogen into water. Enzymes act in the same way with organic substances; they are organic catalysts. Our bodies produce many kinds of enzymes, each of which has its own job to perform. Thus, in digestion *ptyalin*, found in saliva, is active in the conversion of starch into sugar; *lipase* of the gastric juice hurries up the reduction of fats into simpler compounds (*see* Digestion). Every cell in the body contains enzymes both for transforming food into cell substance and for dissolving the cell itself.

In plants, too, enzymes are busy. The yeast plant secretes two enzymes, *invertase* and *zymase*. Invertase first is active in reducing sugar to less complex form; then zymase steps in to complete the change of sugar products into alcohol and carbon dioxide.

Enzymes are active in exceedingly small quantities, and the chemical reactions they stimulate are very rapid. Chew a piece of bread for a moment. Almost immediately it becomes sweetened in your mouth. The enzyme ptyalin has done its work. Cut an apple in two and expose it to air. In a short time it turns brown. An enzyme of oxidation is on the job.

The complex and unstable nature of enzymes has foiled attempts to determine their chemical composition, but we know that they are essential factors of growth and nutrition, of life and death. (*See* Gland.)

EPICTE'TUS. "I was Epictetus, a slave, maimed in body and a beggar for poverty, yet dear to the immortals." This epitaph was written for the "saint of heathendom," the Greek Stoic philosopher who lived in the first century after Christ, and whose virtuous life and teachings have been respected ever since by pagan and Christian alike. Man must find happiness within himself, Epictetus taught, and not in his surroundings. "No one is a slave whose will is free." "Remember that thou art an actor in a play, and of such sort as the Author chooses, whether long or short. If it be his good pleasure to assign thee the part of a beggar, a ruler, or a simple citizen, thine it is to play it fitly. For thy business is to act the part assigned thee, well; to choose it, is another's."

The name Epictetus is merely the Greek for "acquired," which denotes his servile condition. His real name is unknown. He was born in Phrygia about 60 A.D., and when a boy he became the property of a freedman of the emperor Nero, who took him to Rome. There he managed to attend the lectures of Musonius Rufus, who acquainted him with the Stoic philosophy; and after he gained his freedom Epictetus himself began to give lessons. About 90 A.D. the emperor Domitian banished all philosophers from Italy, and Epictetus went to Nicopolis, in Epirus, where he opened a school. He continued to teach the doctrines of Stoicism until the time of his death. He wrote nothing, but talked in a familiar way with his pupils concerning the conduct of life. Arrian, his favorite pupil, took down much of his teaching, which is preserved in two treatises—the 'Discourses' and the 'Encheiridion' ('Handbook'). The year of his death is unknown.

EQUINOX AND SOLSTICE. Twice a year—once about March 21 (the vernal equinox) and again about September 23 (the autumnal equinox), each pole of the earth is equidistant from the sun, and day and night are equally long. The latter fact gives rise to the name equinox (from Latin *aequus*, "equal," and *nox*, "night"). However, instead of lasting an entire day and night, the equinox, as shown by the pictured explanations in the article on the earth, occurs at the exact instant when the line of intersection between the planes of the earth's orbit (the ecliptic) and its equator, sweeps through the centers of the earth and the sun. The clock time of this varies according to one's location on the earth. The time varies also from year to year because, as explained elsewhere (*see* Calendar), the earth does not complete its journey around the sun in an exact number of days, and also because of the precession of the equinoxes (*see* Earth). Equinoxes and solstices occur about 5 hours 55 minutes later each year, the vernal equinox usually coming later and later on March 21, then dropping back to March 20 every leap year, with corresponding times for the autumnal equinox and the solstices.

The solstices (standing still of the sun) come midway between the equinoxes—the summer solstice, on June 21 or 22, when the north pole is nearest the sun, and the winter solstice, on December 21 or 22, when the south pole is nearest the sun. The article on the earth explains the relation of these occurrences to the seasons. (*See also* Seasons.)

ERICSSON, JOHN (1803–1889). This Swedish-American inventor and engineer, who became famous through his construction of the ironclad *Monitor* (*see* Monitor and Merrimac), was not, however, a man of one invention, nor was he unknown before that memorable day in March 1862. As a boy in Sweden he showed a mechanical bent very early—so early that at 12 years of age he was apprenticed as a draftsman. From 1820 to 1827 he was in the Swedish army, where his excellent military maps won him a captaincy. Then he obtained leave to go to London, and in partnership with John Braithwaite he competed for a prize offered for a steam locomotive by the Liverpool and Manchester Railway Company. The competition, however, was won by Stephenson instead of Ericsson. But the latter went on with his work of inventing, and completed various marine inventions. He built a new kind of naval engine which was to be placed below the water line, and won

a prize of $20,000 from the British admiralty for the invention of a screw propeller. In 1838 he designed the engines and propeller used by the first vessels to cross the Atlantic in regular steamship service.

The United States government became interested in him about this time and ordered an iron vessel at a British shipyard to be fitted with his screw and engines. Ericsson followed the boat across the Atlantic and set himself up in New York in 1839 as a builder of ships. His struggle was long and hard, but finally his many useful inventions gave him a considerable fortune. His invention of the *Monitor*—that ironclad "cheese-box on a raft," with its revolving gunturret—revolutionized naval construction. Later he became interested in torpedoes and motors driven by solar heat.

ERICSSON
Inventor of the 'Monitor'

Ericsson had become a citizen of the United States in 1848; but when he died, in 1889, his body was, at his request, taken to Sweden on an American warship where it was buried with many honors. In Stockholm, Sweden, and in New York City, monuments have been erected to his memory.

ERIE, LAKE. So treacherous is Lake Erie, and so long is its tale of shipwrecks in earlier days when vessels were smaller and less seaworthy, that it has been called "the marine graveyard of the Inland Seas." It is the shallowest and stormiest of the Great Lakes, with its surface 572 feet above sea level and its greatest depth only 210 feet. Fourth in size of the five Great Lakes, covering about 9,940 square miles and 241 miles long, it boasts four out of the seven greatest lake ports—Detroit, at the western end where the Detroit River, Lake St. Clair, and the St. Clair River join it with Lake Huron; Buffalo at the eastern end where its waters roar over Niagara Falls and down the rapids of the Niagara River into Lake Ontario, 326 feet lower in level; and Toledo and Cleveland, on the Ohio shore. (*See* Great Lakes.)

Near Sandusky, Ohio, on Sept. 10, 1813, Oliver Hazard Perry defeated British forces in one of the decisive naval battles of the War of 1812. (*See* Perry, Oliver Hazard.)

ERMINE. A quick, restless, brave, and bloodthirsty little animal is this member of the weasel family, related to the mink. It has a slender body, about ten inches long, and short legs. It runs swiftly and climbs and swims well. Making its home among rocks and stones, it feeds on smaller animals such as birds, rats, mice, and chickens, sucking the blood of its prey. It is found in Europe as far south as the Alps and in Asia and North America.

The ermine owes its interest chiefly to its fur. In summer this is reddish-brown above and yellowish-white underneath and the animal is then often called the "stoat." In winter the fur changes to a beautiful white, all except the tail, which has a black tip. The ermine fur used in trade is the white fur with the black tips inserted in regular order. This was formerly used in the linings of the robes of kings and queens and is still used for the robes of judges in England. The pure color of the fur has made it the symbol of the purity which should attach to the office of judge. The best ermine furs are imported from Siberia, Lapland, and the Hudson Bay territories. Scientific name of Russian ermine, *Putorius erminea.*

GROWER OF THE "ROYAL ERMINE"

This little weasel-like animal produces one of the most highly prized furs we know. Its coat changes color with the seasons, but the white "winter coat" is the one which fashion fancies.

ESKIMOS. When explorers first reached the Arctic lands, they found the Eskimos living much as some of them do today. Then, as now, they were scattered all along Labrador and the north coast of America, on the Arctic Islands, on Greenland, and on a part of the Siberian coast. They are closely allied to the natives of the Aleutian Islands, off the Alaskan coast; and many scientists believe that they are of the same stock as the American Indians, whom they resemble in their straight black hair, obliquely set eyes, and brown skin. Although they are so widely scattered, all Eskimos are extraordinarily alike in language, habits, and appearance. Some tribes, in districts farthest south, have adopted many civilized ways from the white people of the settlements. They learn readily and show marked intelligence. They are cheerful and merry, fond of music, and excellent mimics. Generosity, hospitality, and friendliness to strangers are characteristic traits. Warfare is almost unknown to them. They take good care of the children and the aged, and share their food with one another.

Although the Eskimos cover such an expanse of territory, they probably do not number over 40,000. Their villages are small, with from 25 to 200 inhabitants. There is no chief and no form of government. Each tribe has its own territory. Sometimes all the people of a village will be found living in a community igloo, where all share alike. Most of the Eskimos of West Greenland, Labrador, and Southern Alaska have accepted Christianity. The name "Eskimo" was given them by their Indian neighbors and means "eaters of raw flesh." Their own name for themselves is "Innuit," meaning "men," or "people."

A Day's Visit in ESKIMO LAND

TODAY you shall be the guest of Kessuh, the Eskimo boy, whose home is in the Great White North. Of course you have heard of this strange brown-skinned race—who live so much of the year without sunlight, who drive dogs instead of horses, never eat butter and bread, and whose men and women dress exactly alike. Now you are to see them for yourself.

Kessuh has brought you a suit of furs, such as all Eskimos wear, for your sweater and overcoat will never keep out the biting cold of a Greenland winter. The shirt is made of the skins of the dovekie or the murre. Also Kessuh brings you a caribou skin coat, or perhaps one made of about ten blue fox skins, like the coats Kessuh's mother and sisters wear. And you get trousers made of a polar bear's hide. When, with all this, you have put on the high seal boots and fox mittens, you feel very much of a zoo!

ESKIMO HOUSES BUILT OF SNOW BLOCKS

Snow igloos or huts are used by some Eskimos as temporary shelters on hunting trips, and by other tribes as winter homes. Two men can build an igloo very quickly. One cuts blocks of snow, shaping them so that they will tip inward and form a dome as the other man sets them up. The square holes in the roof are windows. They are filled with sheets of clear ice or pieces of transparent seal intestine, frozen firmly into place.

Now you are off for the village. The long winter darkness has begun, and although by your watch it is mid-morning, you travel by starlight, for the sun has disappeared for months from the Arctic regions. In the dim twilight you look in vain for streets. You see only a few scattered snow-covered mounds.

Kessuh stops before one of the mounds and motions you to follow. On your hands and knees you creep through a stuffy tunnel. This is the hallway to Kessuh's house or "igloo." You find that it has only one low smoky room, half under ground, a sort of cave walled up with rocks and chinked with moss and earth. Sometimes when on a journey, the Eskimos build their conical-shaped igloos of rectangular blocks cut rapidly from the snow or ice.

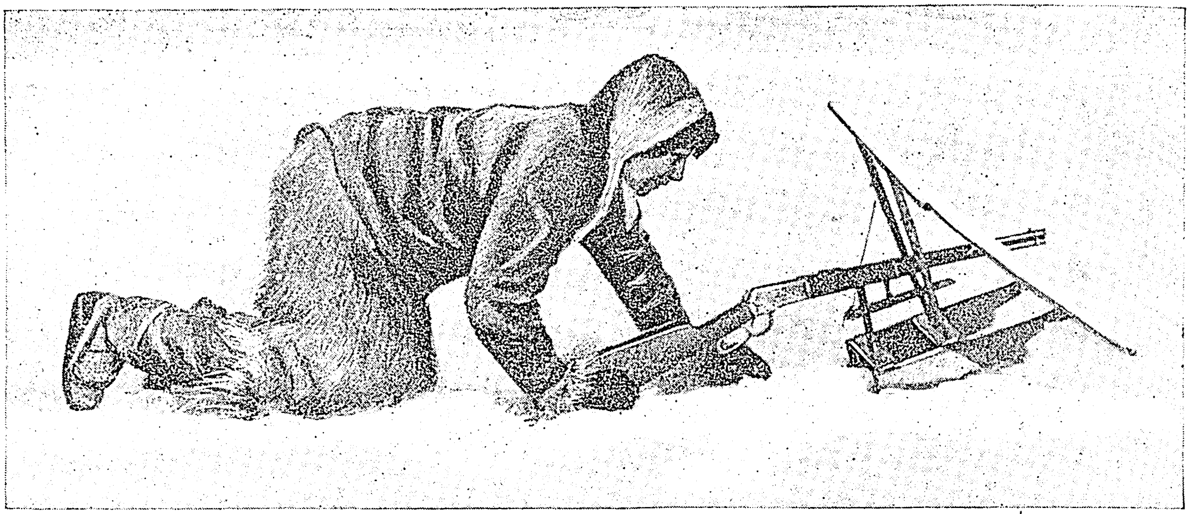
This Little Cook Stove Lights the House

The room is lighted by a strange lamp, a rude kind of basin shaped from soapstone and filled with whale or seal fat. The burning wicks of twisted moss give out heat as well as light, and over this lamp-stove Kessuh's mother is boiling his dinner. But Kessuh does not care much for cooked meat; he is just as happy with a piece of raw frozen fish or bear flesh.

Kessuh's sister is sewing bird skins together to make a shirt. Her bone needle looks clumsy, and she uses sinew for thread; but she makes a very neat seam.

The father is making a bow from the rib-bone of a whale. He is stringing it with a thong of fox-hide. Now he lays it aside to eat a great piece of raw flesh which the mother has cut from a half-skinned seal that lies on the earth floor. He is a short stocky man, not more than five feet four inches high. In his furry clothes he looks like a roly-poly bear, for his walk is almost a waddle

CAMOUFLAGE AND STRATEGY OF THE SEAL HUNTER



This young Eskimo hunter of Etah—the most northerly village in the world—is crawling up behind a seal. He is partially hidden behind a white screen and pushes his rifle along ahead of him on runners. The Eskimos show themselves very ingenious in many things they have invented, and you see how quickly they apply this inventive faculty in the use of modern weapons. Of course such Eskimos are very far removed in the ways of living from the primitive tribes described in the story.

On one side of the room is a low platform made of rock. You follow Kessuh to the platform and there among the furs that cover it is an Eskimo baby, with only its head sticking out of a bag of hareskin. Kessuh lifts it up and rubs his nose against its funny little flat nose. The sister leaves her sewing and comes to rub noses with the baby too. This is the Eskimo way of kissing. The mother seeing the baby awake brings a handful of seal blubber. She feeds the baby a bit, and he crows and reaches for more. Kessuh and his sister look longingly at the greasy tid-bits. Their mother gives them each a piece and they smack their lips over it. She offers you one and when you shake your head and say, "No, thank you," Kessuh looks surprised. He thinks it very strange that you do not like their Eskimo "candy".

The mother takes the baby up and puts it into a long fur hood at the back of her coat. Here it rides contentedly as she goes about her work. She is shaking and rubbing some wet skins that hang on a drying-rack, which also is made of bones. On this same rack are sets of strong hide straps. These you think must be the dog harness. You remember that it has to be kept out of reach or the dogs would eat it. They are always hungry.

Ka-Ka-Chee-Ah (that's his name) is a skilful hunter of seals, but he uses the primitive weapons. He has in his left hand his harpoon, with which he spears the seal, while in his right is what is known as the "killing iron" for dispatching the animal.

In the room you may find someone eating, or sleeping, at any time of day. For the long months of darkness, and the months of continual daylight, have kept the Eskimos from having any notion of regular hours for meals or for bed time. Though it is 2:00 a.m., Kessuh takes up the harness and beckons you to come on outdoors for a spin over the snow.

You are glad to leave the close ill-smelling room. You find the wild wolfish dogs lying in the tunnel hallway. They follow Kessuh, crowding and yelping about him, as he goes to the *cache*, a snow cave, and takes out pieces of frozen walrus meat for them. The moon is now shining and you watch Kessuh and his sister get the sledge and dogs ready for the ride he promised you. You examine the low runners and crosspieces, so skilfully made of bone. It is very light but it is also very strong, as you find when wrapped in a fur robe you go for a swift ride over the white

fields. Kessuh sits in front and guides his ten dogs with a long leather whip as easily as you turn your pony team.

If you could understand Kessuh's language he would tell you many thrilling tales as you glide along. He would speak of the bright summer when for whole months together the sun does not set on his Arctic home, and the ice breaks up in the bays and inlets. Then comes the exciting times when the caches are filled with game for winter food. This Arctic summer is one long hunting party. The Eskimos leave the unwholesome igloo and live in "tupeks" or tents of skin, which they can carry about with them as they search for game.

AN ESKIMO MOTHER AND BABY

Although this Eskimo mother loves that baby so much, she never kisses it, of course; she rubs noses with it. Mother and baby are standing in front of an Eskimo house made of blocks of solid snow, but their clothes come from civilized lands.

What a Lot Kessuh Knows about the Out-of-Doors!

Kessuh could tell you where the eider duck fills her down-lined nest with eggs, where the great white owl makes his home, where the little auks gather, and how, hidden among the rocks, he catches hundreds of them in his homemade net. He could tell you how, in his wonderful little "kayak" or waterproof boat made of skin stretched over a bone framework, he helps land the great whale that the men of his tribe have harpooned. You would like to see this harpoon. The point is detachable, and to it a drag and an inflated sealskin bag are fastened. The drag helps exhaust the wounded animal, and when the animal is dead the float on the surface marks the place for the hunters. Kessuh uses this weapon when he surprises the walrus asleep on the ice, or when he sits patiently by the air hole of the seal until, with a sudden stroke of the spear, he makes sure of seal blubber and a warm skin for the next winter. Then too you might hear an exciting bear story, for a bear hunt with the crude instruments of the Eskimo is risky business.

But you would find it hard to talk with Kessuh, even if you knew his language. You would find that he has no word for school, church, train, automobile, book, pencil, and many other things of which you speak every hour. He knows only of ice and snow and of such animals as live in the very coldest parts of the world. He may have a word for store, because in some parts of the Arctic regions there are trading posts or settlements, where the more progressive Eskimos go to trade furs for needles, knives, tools, and the white man's food.

Saying Goodbye to Kessuh

When your ride is over, Kessuh leaves you at your ship. You want to give him a present. There is nothing in the world he would like so much as your pocket knife, for he has never seen one like it. When you slip it into his hand and make him understand that it is for him to keep, he is so happy you are afraid he is going to rub noses with you. You watch him drive away, feeling very glad that you are not going back with him to sleep in his igloo.

ESPERANTO. Many attempts have been made to invent a new universal language to serve the purpose that Latin served in the Middle Ages. Volapük, which was given to the world in 1879 by Johann Martin Schleyer, a German priest, attained a measure of success, but just when its triumph seemed assured, dissensions arose among the leaders.

Meanwhile, however, Esperanto was developed and it soon outstripped all other artificial languages. It was the work of Dr. Zamenhof, a Russian physician and scholar, who presented it to the public in 1887, the name Esperanto coming from the Spanish for "hope." It uses sounds and words common to all the European languages, dropping what is special to any one of them. The grammar is very simple, and many students have mastered Esperanto in a few months. About 200 periodicals and some thousands of books have been printed in Esperanto. Here is a stanza from a poem by its founder, with an English translation:

Sur neutrala lingva fundamento,	On a neutral lingual foundation,
Komprenante unu la alian,	Understanding one another,
La popoloj faros en konsento	The peoples shall form in agreement
Uno grandan rondon familian.	One great family circle.

ESSAY. It was in the tower of an old castle inFrance, in the year 1571, that the first "essay" was written. Michel de Montaigne, a cultured French gentleman, had retired there to forget the cares of the busy world, and to read and meditate in quiet. A desire to "preserve his memories" and "clarify his reflections" led him to write. He called the little book, which he began at this time and published in 1580, "Essais"—meaning "attempts" or "trials."

The term essay, which was soon adopted in England, thus suggests that the author is merely touching upon the subject in hand, and not treating it exhaustively; giving a short comment rather than a complete and formal discussion, as in a "treatise" or "monograph."

"Myself am the groundwork of my book," said Montaigne, and indeed it is mainly the author's personality as he reveals it to us that makes a good essay.

Unlike the novel or the short story or the drama, the essay does not aim primarily to create characters and through them to tell a story. It speaks directly to the reader, giving the author's views on customs or happenings or people, on art, on books, or on life in general. It may teach, argue, persuade, arouse emotion, or merely amuse. Its subject may be almost anything, from 'Easter Bonnets' to 'Grand Opera'.

Though French in origin, the essay form appealed especially to the English. After Montaigne, an Englishman, Lord Bacon, was the next great writer of essays. He called his essays "certain brief notes set down rather significantly than curiously" and spoke of them also as "dispersed meditations." As a matter of fact, his essays are very compact and written with painstaking care. They are somewhat more formal and less personal than those of Montaigne.

When magazines and newspapers began to be published, the essay became especially popular. In two periodicals, published in London in the beginning of the 18th century, called *The Tatler* and *The Spectator*, Addison and Steele wrote essays commenting on the life of the time, the most famous being the Roger de Coverley papers.

Then in the 19th century came one of the most delightful of essayists—Charles Lamb, who, though he hid under the pen name of "Elia," revealed his whimsical lovable personality as few writers have done. His humorous 'Dissertation on Roast Pig' and his tender and pathetic 'Dream Children' are inimitable. At about the same time Macaulay wrote essays of a very different type. They are very carefully organized and noted for the clearness of their style and the splendor of their diction. Macaulay's essays, that on Milton for example, may be taken as typical of the formal essay, as Lamb's 'Essays of Elia' are representative of the familiar or informal essay.

Of the essayists who followed, some leaned more toward one type and some toward the other, but each wrote in his own way. Hazlitt, Carlyle, Ruskin, Thackeray, Matthew Arnold, and Stevenson are among the greatest essayists in England. In America Washington Irving in his 'Sketch Book' and Oliver Wendell Holmes in his 'Autocrat of the Breakfast Table' used the essay form with great success, and Emerson's ethical essays became especially famous.

Today we meet a form of the essay every day in the editorials of the daily newspapers, while in our magazines the essay still occupies a prominent place and for some readers has a stronger appeal than the more exciting short story. (*See* Writing.)

ESSEN, GERMANY. For more than 800 years, Essen was a small town of no importance. Here, in 1811, Friedrich Krupp opened a blacksmith shop with two workmen. This marked the beginning of a great iron and steel industry. Today, Essen is the Pittsburgh of Germany. The firm of Krupp is Europe's chief producer of iron and steel castings and has the world's largest machine shop. The near-by settlements for the workers alone are cities in themselves.

Essen lies in northwest Germany, near the junction of the Rhine and the Ruhr rivers. The Ruhr Valley is Germany's chief coal field, providing fuel to smelt the iron ore brought in by boat from the Siegerland and other Rhine districts.

The city's industry is centered in the Krupp works. These have long been Germany's chief arsenal for giant naval guns and other war materials. They also make locomotives, trucks, and industrial and agricultural machinery. In the second World War the British Royal Air Force made this plant one of its chief objectives and bombed it severely night after night. (For picture, *see* Germany.)

The multitude of factories massed in the city gives it a somewhat gloomy aspect. This is relieved by parks, lagoons, plazas, museums, and historic buildings. The Münster-Kirche, dating from the 9th century, is one of the oldest church buildings in Germany.

Essen takes its name from a Benedictine nunnery, founded here in the 9th century. The rights of a town were granted Essen in the 10th century. The abbess of the nunnery governed from 1275 until 1803, when Prussia took control. Population, about 660,000.

ESTATES-GENERAL. When Philip the Fair of France needed help in his struggle with the pope in 1302, he called together representatives of the nobles, of the clergy, and of the townsmen of France, the three estates or classes, in order to gain their aid. Although there were meetings of similar partial groups in the preceding ten years, this date may be taken as the first meeting of the Estates-General of France, which in the beginning corresponded roughly to the Parliament of England, not yet 50 years old.

The French monarchy was more firmly fixed in power by the unfailing succession of the Capetian line, and the Estates-General never gained the right to make laws as the English Parliament did. The three estates never fused and the lower or third estate always lacked that leadership from the upper classes which the lower clergy and barons gave the Commons in England. Neither was there in France that tradition and practice of local self-government which prevailed in England. During the Hundred Years' War (1337–1453) the Estates-General could frequently force the king to do as it wished by refusing him money to carry on the struggle, but it as often forfeited public respect by favoring civil strife or even by allying itself with the English invaders. Near the close of the war (1439) it granted a land tax, the *taille*, from which the nobles were exempted. This favored and powerful class no longer had a good reason, as did the barons of England, for allying themselves with the Commons, and there was therefore no opposition when the king chose to consider such grants perpetual. As a result the king became independent. He had plenty of revenue, he had a standing army, he dominated the clergy and dispensed favors to the nobles, and so had little need of the Estates-General. Successive kings and great ministers found its opposition to royal power increasingly easy to break.

For 175 years (1614–1789) the representatives of the three estates were not summoned to consider the affairs of the kingdom. But in 1789 the treasury was empty, and Louis XVI was forced as a last resort to call this almost forgotten body together again. When it met, May 5, 1789, the representatives of the third estate, equal in numbers to the other two, refused to vote according to the old method, each estate casting one vote. They insisted on voting as individuals. Led by the bolder spirits they declared themselves the National Assembly, and on June 20, 1789, they took the famous "Tennis Court" oath not to disperse until they had given France a constitution. This bold attitude showed clearly that a revolution was at hand. (*See* French Revolution.)

The name estates-general was not uncommon in medieval Europe. In Spain there were four estates or classes in the assembly. In Holland the name States-General is still applied to the legislative body of that kingdom. It is composed of two houses, the upper elected by the provincial assemblies and the lower chosen by the people.

The JEWISH MAIDEN *who Became* QUEEN *of* PERSIA

ESTHER. In a beautiful Bible story we are told how the mighty king Ahasuerus of Persia chose from among all the maidens in his kingdom the one he deemed fairest to be his Queen. This was a Jewish maiden named Esther, although the king knew not who were her people or her kindred. Her father and mother were dead and she had been reared by her cousin Mordecai.

But shortly after Esther became queen, a great disaster threatened her people. A haughty man named Haman had been raised to the highest office in the kingdom, and he demanded that all should bow down before him. Mordecai refused to bow down and for this Haman hated him so that he wished to destroy not only Mordecai himself but all the Jews. The king allowed Haman to do what was good in his own sight and the wicked officer issued a decree that on a certain day all the Jews, young and old, throughout the kingdom should be destroyed.

When Mordecai heard the dreadful news he begged Esther to intercede with the king. Esther dared not approach the king, for there was a Persian law that anyone who entered the presence of the king without being called must die, unless the king showed mercy by holding out his golden scepter. But at last thinking that she may have been raised to her high station for the very purpose of saving her people, she said, "I will go in unto the king, and if I perish, I perish."

Clad in her royal robes, Esther approached the king's inner court. Ahasuerus, seated on his throne, was so moved at sight of her that he held out his golden scepter and bade her approach. "What wilt thou, Queen Esther?" he asked. "What is thy request? It shall be given thee, even to the half of the kingdom." Esther's only request was that he and Haman should come that day to a banquet that she had prepared for them. When they were banqueting, the king again asked Esther if she had any request, and she asked the king and Haman to come again tomorrow to the banquet; and then she would tell the king what she desired of him.

Haman Has a Gallows Built

Haman was very much elated at being invited to feast with the king and queen. But when he saw Mordecai, he was so filled with wrath, that he caused a gallows to be made on which to hang him.

Now some time before this, Mordecai, as he sat at the palace gate, had chanced to overhear two of the royal chamberlains plotting against the king's life. He told Esther and she warned the king. Thus the king's life was saved, and so it was written in the book of records. The night before the second banquet, the king could not sleep, so he called his attendants to read to him from the records. And they read how Mordecai the Jew had saved the king's life. "What honor has been done to Mordecai for this?" asked the king. "Nothing has been done for him," was the reply. While they were speaking Haman came into the outer court. He wished to ask the king to hang Mordecai on the gallows that he had prepared. The king bade him come in and said to him, "What shall be done unto the man whom the king delighteth to honor?" Then Haman thought to himself, "I am the man whom the king wishes to honor," and he replied, "Let the man whom the king delighteth to honor be arrayed in the royal apparel and the royal crown be set upon his head, and let him be placed on the king's own horse; and let one of the king's most noble princes lead him through the city and proclaim before him, 'Thus shall it be done to the man whom the king delighteth to honor.'"

Haman is Hanged on His Own Gallows

Then said the king, "Make haste and take the apparel as thou hast said, and do so even to Mordecai the Jew." And so Haman was forced to array the despised Jew in the king's robes and lead him through the city, proclaiming before him, "Thus shall it be done to the man whom the king delighteth to honor."

The next night when they were at the banquet, the king said to Esther as before, "What is thy petition? and it shall be performed even unto the half of the kingdom." Then Queen Esther said, "If I have found favor in thy sight, O king, spare my life and that of my people, for we are to be slain." "Who is he that dares to do this?" said the king. And Esther answered, "Our enemy is the wicked Haman." The king arose in his wrath and went into the palace garden, and one of the servants showed him the gallows that Haman had built for Mordecai. "Hang Haman thereon," commanded Ahasuerus. And so they hanged Haman on the gallows that he had prepared for the execution of Mordecai.

Mordecai was raised to the highest office in the kingdom, and the day that was to have been a day of sorrow to the Jews was made a day of joy and gladness. So is its anniversary to this day, for it is still celebrated as the festival of Purim, and on this day the Book of Esther, which tells her story, is read in their synagogues.

ESTHO'NIA. Bordered on the north by the Gulf of Finland and on the west by the Baltic Sea, Esthonia (also spelled *Estonia*) is the most northern of the Baltic States which were liberated from Russian rule during the World War of 1914–1918—only to return in 1940 as Soviet republics. It is a low flat land, with many lakes, streams, and marshes. The mild climate is favorable for agriculture, and farming and dairying support almost three-fourths of the people. The use of modern farm equipment and methods is increasing, though the small farms are not adapted to the use of many large-scale farming machines. Butter, timber, and flax account for more than half the total exports. Cotton goods, paper, and matches are important manufactures.

Oats, rye, barley, potatoes, flax, wheat are the leading agricultural products. Cattle, sheep, and hogs are raised, and poultry-farming is increasing rapidly. Esthonia now has a trade balance in her favor, is connected by air routes with important European centers, and has reduced illiteracy to the very low rate of 5.6 per cent.

The Esths, or Esthonians, who make up about 90 per cent of the population, are a Finnish people, with oblique eyes, broad faces, and low foreheads. They speak a language much like that of the Finns themselves, a language which is Mongolian and not European in its relations. In religion they are Protestants, in spite of the attempts of czarist Russia to convert them to the Greek Catholic faith.

Esthonia was first conquered and christianized by the Order of Teutonic Knights. It passed into the hands of Sweden in 1561, but was ceded to Russia in 1721. It remained under Russian rule until the collapse of the imperial government in 1917. A republic was proclaimed in February 1918. In June 1940, having already exacted sweeping military and trade concessions, Russia concentrated troops in Esthonia. Esthonian Communists then seized power and in August the country was incorporated in Russia as the sixteenth Soviet republic. (*See also* Russia.)

Tallinn, with a population of about 145,000, is the largest city and the chief seaport. Area of Esthonia, 18,359 square miles; population, about 1,125,000.

ETHER. The action of sulphuric acid on alcohol produces the light, volatile, and pungent liquid called ether, which is extensively used in industry as a solvent of fats and oils, and in medicine as an anesthetic (*see* Anesthetics).

ETHER AND SPACE. Of what does space consist? What can we say about the vast stretches through which the earth, the sun, and the most distant stars are moving? We may be tempted at first to reply that space is simply emptiness. But that will not do, because in space things *happen*. Light, for example, travels across space; so do heat rays; so does the attraction of gravity. And to the human mind it seems somehow impossible that action could be transmitted through an absolute void.

Early in the history of modern science, the *ether theory* was formulated and quite generally accepted. Ether was thought of as a material which filled all space, even permeating the areas occupied by ordinary matter. It was assumed to possess a variety of properties to account for its supposed action.

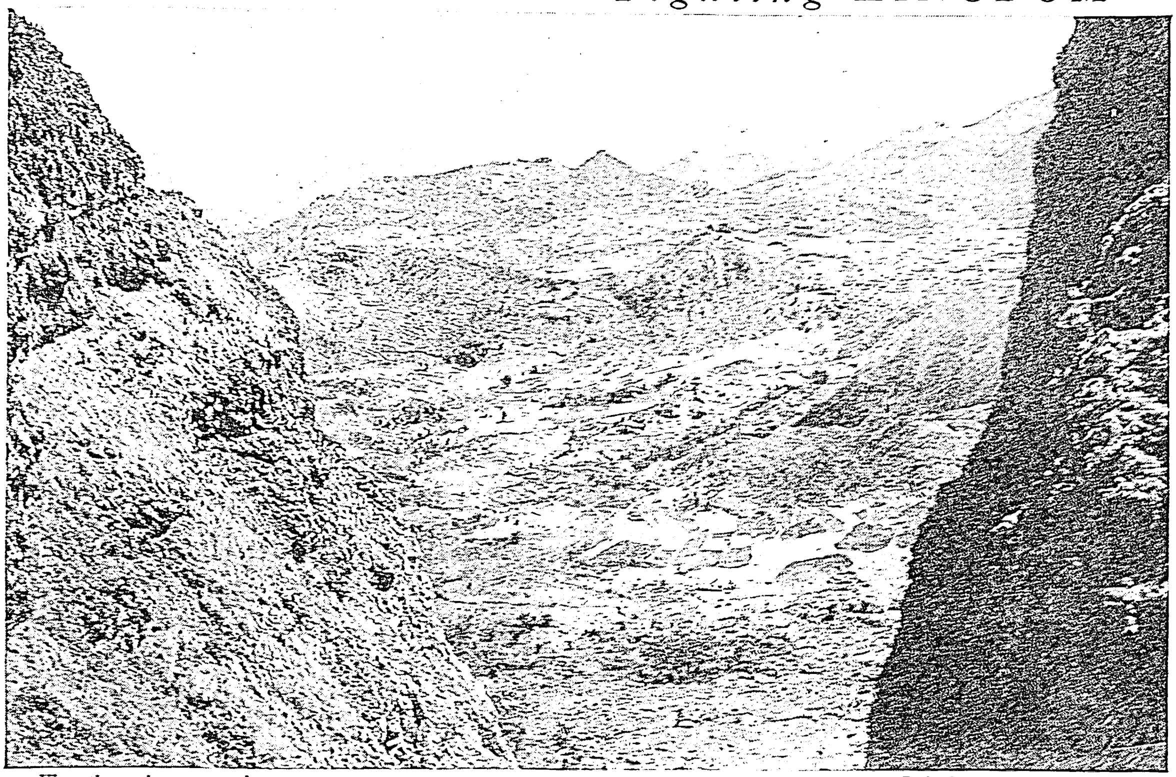
When Einstein's theory of relativity led to new mathematical descriptions of space and its phenomena, the ether theory was believed by many scientists to be no longer necessary. Furthermore, the old theory implied that the drift of the ether past the moving earth ought to be measurable; but several elaborate experiments to detect this "ether drift" failed. Today some scientists continue to use the term ether with a much altered meaning; others have discarded it entirely in favor of the plain word "space." (*See also* Atoms and Electrons; Einstein, Albert; Light; Physics; Radiation.)

ETHICS. Is a starving man entitled to take food that does not belong to him? Are we ever justified in telling a falsehood? Why do we classify certain actions as faults, and others as virtues? These are all questions that belong to the field of "ethics," that branch of philosophy which deals with human actions from the moral point of view, as right or wrong, good or bad. Its field is character and conduct, and the moral judgments we pass upon them.

You might, perhaps, suppose that there is no difficulty in deciding between right and wrong; and there is a certain field in which custom or tradition furnishes an undisputed standard. We know that we should not go out and murder our neighbors or steal their property. The only moral problem that arises in such instances is the practical one, whether we will do what we know is right. But there are cases in which we do not know what we ought to do. Suppose a manufacturer wants to pay his laborers a living wage but finds himself in competition with other people who do not. If he raises his wages he goes into bankruptcy. What shall he do? In solving such problems ethics insists that we must act with reference to all the facts involved. We must see all the things that are worth while, and act with reference to all these "values."

The term "ethics" is derived from a Greek word meaning "manners," "customs," or "habits," just as "morals" is derived from a Latin word with a similar meaning. Some philosophers—those of the naturalistic school—believe that our present ethical system is the outgrowth of very slow and unconscious alterations of these habits and traditions. Others, however, believe that standards are not truly ethical unless they are the result of reflection and conscious criticism of these habits and customs. (*See also* Philosophy.)

ETHIOPIA—AFRICA'S *Fighting* KINGDOM



View through a mountain pass 75 miles northeast of Addis Ababa and 11,000 feet above sea level. This fiercely rugged region is typical of the western half of Ethiopia. In the valleys nestle fields cultivated by people who for centuries have divided their time between farming and fighting.

ETHIO′PIA. Though in recent years Ethiopia has been the object of rivalry and conflict among the nations of Europe, few white men have even explored the remote interior of this ancient kingdom. It lies in northeastern Africa, high on a mountainous plateau fringed by desert. The people are simple but warlike, and they live for the most part under the same conditions that have prevailed for untold centuries.

Mountains and highlands make up most of the country. Days are sunny except for summer rains, from mid-June until the last of September. The country is so high that, even though it lies only a few degrees north of the Equator, the climate is bracing. The lower mountain slopes offer good pasture for live stock; and the two great central plateaus, separated by the gorge of the Hawash River, have fertile soil and abundant rainfall for raising tobacco, grain, fruit, and potatoes—often two or three crops a year. In the valleys grow sugar cane, cotton, rubber and timber trees, and especially coffee, which grows wild. Coffee is said to be named for the Ethiopian province of Kafa. Native methods of cultivation are primitive, and only a fraction of the land's possibilities has been developed.

HAILE SELASSIE

Emperor of Ethiopia. His headpiece is crested by a lion's mane.

Nothing grows in the sandy deserts which hem in the country; but oil is believed to underlie some of them. Falls and rapids make the rivers useless for transportation, except the Baro, which is navigable from Gambela into Egypt. Electrical power is being developed along some of these streams.

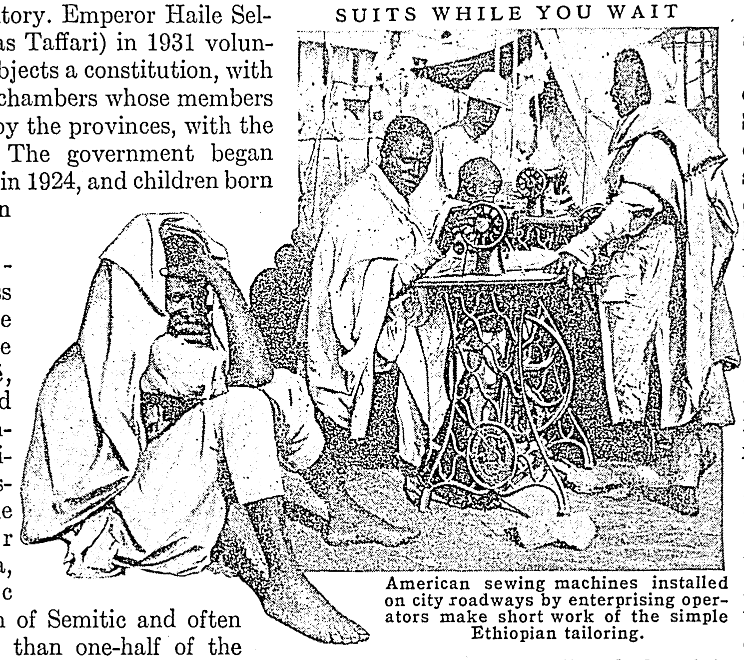
Most Ethiopians are still a very primitive people who, until recently, defended their tribal strongholds armed only with curved swords, spears, and shields of rhinoceros hide. At ceremonial feasts they gorge themselves with raw beef, but their daily diet is bread baked of various cereals, butter, and a peppery bean mixture washed down with beer or a drink made from honey. Salt is so scarce that bars of it circulate as small change. Except in the few cities, the people live in thatched huts made of mud because of the scarcity of wood on the plateaus.

Surrounded by colonies of the great powers, Ethiopia has been able to maintain independence partly because of the skillful diplomacy of its emperor, Haile Selassie. The "King of Kings" (Negus Negusti), as he calls himself, claims descent from Solomon and the Queen of Sheba. He is absolute ruler of some 5,500,000 subjects in about 350,000

square miles of territory. Emperor Haile Selassie (the former Ras Taffari) in 1931 voluntarily granted his subjects a constitution, with a legislature of two chambers whose members were to be selected by the provinces, with the emperor's consent. The government began emancipating slaves in 1924, and children born to slaves since then have been free.

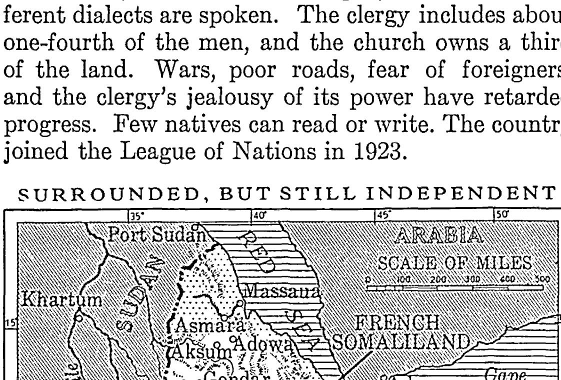
The true Ethiopians, numbering less than a third of the population, live in the provinces of Tigré, Amhara, Gojjam, and part of Shoa in northern and central Ethiopia. They are Christians, members of the Coptic church, or Church of Alexandria, and are of Hamitic origin, with a strain of Semitic and often negro blood. More than one-half of the people are Gallas, a Hamitic pastoral race which is part pagan, part Christian, and part Moslem. The rest are Somalis, Falashas of Jewish faith, negroes, and a few Greeks and Armenians. The official language is Amharic, an old Semitic tongue; but some 70 different dialects are spoken. The clergy includes about one-fourth of the men, and the church owns a third of the land. Wars, poor roads, fear of foreigners, and the clergy's jealousy of its power have retarded progress. Few natives can read or write. The country joined the League of Nations in 1923.

SUITS WHILE YOU WAIT



American sewing machines installed on city roadways by enterprising operators make short work of the simple Ethiopian tailoring.

SURROUNDED, BUT STILL INDEPENDENT



Under Italian rule after 1936, Ethiopia (shown without shading) was joined with Eritrea (the dotted area at the top) and Somaliland (dotted area below) to form Italian East Africa. Liberated with British aid in 1941, Ethiopia again became an independent monarchy. It is nearly as large as Texas and Utah together.

In recent years some progress has been made in developing the country. Schools and medical centers have been set up, and radio communication has been widely established. Plans are being made to develop the deposits of coal, copper, sulphur, iron, and tin; and some gold, platinum, and mica are now being mined.

Automobile roads link the principal cities and connect them with seaports. Formerly Ethiopia was almost wholly dependent upon the narrow-gauge railroad that joins Addis Ababa with Djibouti in French Somaliland. But now motor trucks bring in most of the imports of flour, sugar, cotton goods, machinery, and building materials, and carry to the sea exports of hides, coffee, cotton, and wax. Apart from the main highways, however, roads are still mere tracks, and goods are carried by caravans of horses, camels, and mules. Bridges are being built, although travelers must still wade many rivers, some infested by crocodiles. The chief river is the Blue Nile, or Abbai, which flows out of Lake Tana (or Tsana), near the western boundary.

Addis Ababa, the capital and largest city, bears clear traces of recent European influence. Paved streets, motion-picture theaters, and modern public buildings adorn the old tree-lined city. Other cities are the ancient walled Harar, center of the caravan trade; the more progressive Diredawa; and Gambeila, a trade center on the Baro River, with steamship service to Khartum. Few other towns exceed 5,000 in population, and villages move often as firewood gives out.

When Portuguese ex-

This chief has killed his lion, as his head-dress and neck-piece of lion's mane prove. Note his modern high-power rifle.

plorers in the 15th century first made their way from the Red Sea into eastern Africa, they found what they thought was the kingdom of Prester John, a legendary Christian monarch of fabulous wealth. In reality, however, they had stumbled upon Ethiopia, which had been cut off from the rest of the Christian world ever since the Moslems had swept over North Africa in the 7th century.

The earliest records of Ethiopia are found on Egyptian monuments. From these we learn that the land was repeatedly raided by Egyptian kings and finally subjected about the 16th century B.C. Under a succession of viceroys, known as princes of Kesh, the province grew in power and wealth. In the 11th century B.C. the Ethiopians threw off the Egyptian yoke, and 300 years later they turned about and conquered Egypt, where they established the 25th dynasty of Egyptian kings. Assyrian conquerors drove them out about 660 B.C.

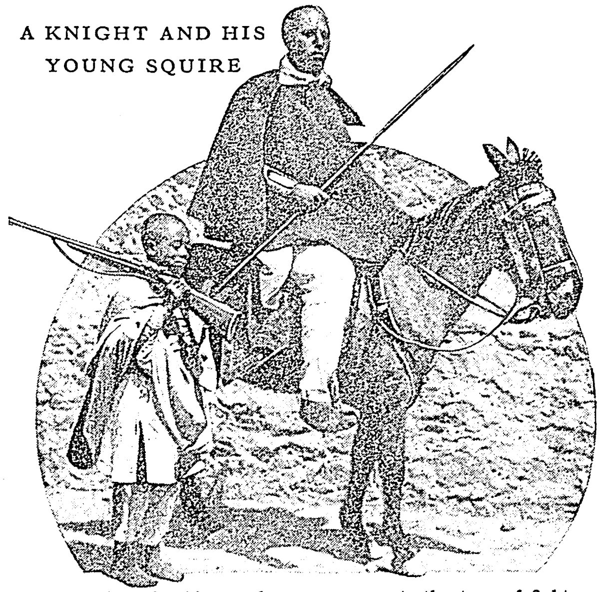
Back in their own land, the Ethiopian rulers maintained their independence, driving off attacks by the famous Persian ruler Cambyses, and escaping free from a brief contest with the Romans. In the 4th century A.D. St. Athanasius of Alexandria converted the Ethiopians to Christianity. They continued to cling to the Christian faith even after the Arab invasion drove them into isolation and obscurity for 800 years.

Schooled in independence, the Abyssinians, as the Arabs had named them (*see* Abyssinia), long successfully resisted the aggressions of European nations, remaining the only independent native state in Africa, except Liberia. British troops, sent in 1868 to free the British legation which had been imprisoned by King Theodore III, stormed and captured the capital only after fierce fighting. Later, during the rule of the famous Menelik II, Italy established the colony of Eritrea on the Red Sea coast and tried to extend its power inland. An Italian army was disastrously defeated in 1896 at Adowa, and in the treaty of Addis Ababa Italy was forced to recognize Ethiopia's independence. In 1906 England and France, which had set up protectorates on the Somali coast, joined with Italy in an agreement to respect the Ethiopian boundaries, since none of these powers was willing to see another gain the advantage in this region.

But a generation later Italy, now under Fascist rule, invaded and seized the country. The conquest, which began in 1935, ended in the capture of Addis Ababa in 1936. Emperor Haile Selassie fled to England. His protests to the League of Nations were futile, and Ethiopia was made part of Italian East Africa.

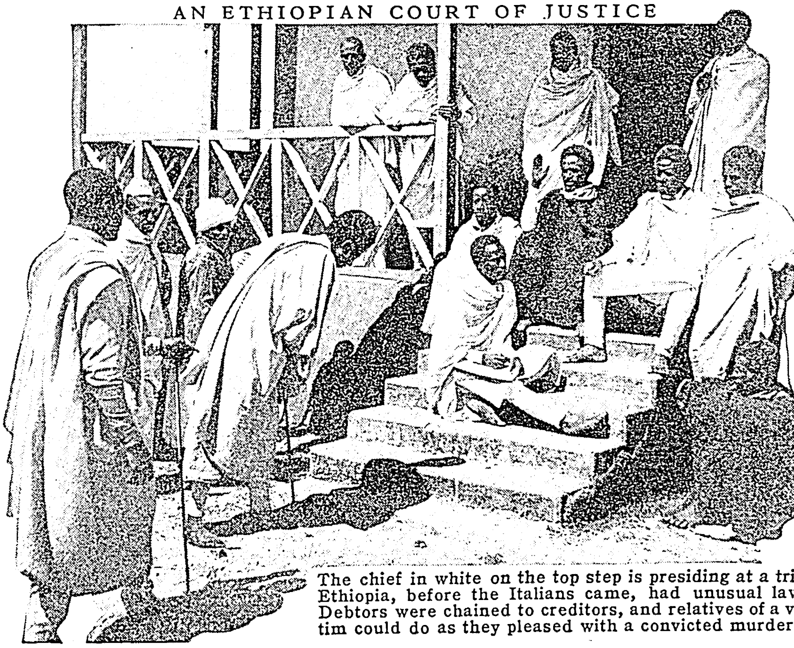
This conquest was one of the series of events that plunged Europe into war in 1939 (*see* Europe). When the conflict spread into Africa, England encouraged the Ethiopians in the guerrilla war they were waging against their Italian conquerors. With British aid, Haile Selassie returned to Ethiopia in January 1941 and led an army of native rebels against Italian outposts. British columns, penetrating from south and west, crushed Italian resistance and took Addis Ababa in April.

A KNIGHT AND HIS YOUNG SQUIRE



This warrior with his gun-bearer represents the type of fighter that attempted to stop the Italian conquest. His mule and equipment show that he is a minor chief.

AN ETHIOPIAN COURT OF JUSTICE



The chief in white on the top step is presiding at a trial. Ethiopia, before the Italians came, had unusual laws. Debtors were chained to creditors, and relatives of a victim could do as they pleased with a convicted murderer.

The PURPOSE *and* PRACTISE *of* GOOD MANNERS

ETIQUETTE. The manners and customs observed by the influential people of a community or a region are spoken of as the *etiquette* of that place. This is a French word which meant first a label or ticket. The new meaning was added during the reign of Louis XIV, whose court functions became so elaborate that the master of ceremonies had to provide each guest with a ticket (*étiquette*) on which were noted the formalities expected of him. Proper behavior, then, was "according to the ticket." In this sense the word etiquette was adopted into English at the end of the 17th century.

Etiquette is necessary to enable people to get along pleasantly together. There must have been codes of manners among all prehistoric peoples who developed any sort of peaceful society. Primitive folk of today, such as Eskimos, Hottentots, and Bushmen, all have their rules of conduct and taboos. To violate one of these rules and taboos may be punished by expulsion from the tribe or by death.

Elaborate codes of manners seem to have originated in the Oriental countries. In China, at one period, there were 3,000 rules of conduct to be learned and obeyed. In ancient Japan a man could be put to death for a rudeness; and a rudeness was defined as a "not-to-be-expected thing."

Origin of Modern Formalities

Much of present-day etiquette has come from the courts which sprang up when tribes grew into kingdoms. Manners then were founded on reverence for the king. The knights who served the king were standard-bearers of courtesy. Many of their principles are in the gentleman's code today—for example, protection of women, refusal to take unfair advantage even of a rival, and care not to humiliate others.

Among the customs which started in those long ago days is the man's custom of removing his hat in the presence of a woman. It began as a gesture of respect and submission between men. The king's crown was the symbol of the supreme authority, and all lesser head coverings were in turn symbols of the rank and power of the wearer. The vassal bared his head in the presence of his liege lord, and even the great noble removed his petty crown when he paid homage to his king. Men of equal rank lifted their hats to one another as a gesture of friendship. After the rise of chivalry in the Middle Ages this mark of deference, respect, and peaceful intention was extended to all gentlewomen. Later when democracy began to level off distinctions of rank, men ceased to lift their hats to one another, but they continued to honor women in this way.

The handshake comes to us from the days when armed men approached one another warily. Extending the bare right hand with no weapon in it was an invitation to friendship and a pledge that no blow would be struck.

While these and many other old customs have been kept, others have changed as our ways of living and our attitudes have changed. The gentleman of the Middle Ages ate with knife and fingers—a shocking thing today, but forks were not introduced into northern Europe until the 17th century. The great 16th century scholar Erasmus wrote in a book of manners that it was girlish for boys to use powder on their teeth to whiten them, but that is not the opinion now. Two generations ago girls who were as athletic as many are today would have been thought hoydenish.

Foundations of Etiquette

In spite of such outward changes, the foundation stones of etiquette—kindness, fairness, self-control, gentleness, and self-respect—have in every age been the same. The important thing about good manners is that they make other people feel at ease. Since rules of etiquette are intended to make others comfortable, it comes about that the qualities which produce good manners help to make a person charming.

Kindness leads you to offer another the better seat, to listen to his opinions, and to avoid embarrassing him either by word or glance. Gentleness keeps you from talking roughly and doing offensive things, such as interrupting another while talking, or coughing in his face. Self-control prompts you to make your voice pleasant and pitched low; to walk without swinging your arms like pump handles; to stand erect, not slouched down on your heels with hands in pockets.

Self-Consciousness—Foe of Good Manners

Self-consciousness prevents many people from being charming. Lack of confidence makes them think constantly about themselves, because they are afraid they are not making a good impression. They feel that others are noticing and criticising them. They may timidly withdraw from conversation, or they may talk loudly trying to hide their timidity. But they are ill at ease and so others do not feel easy with them.

To overcome self-consciousness, take a greater interest in others; think of what may interest them; keep thinking of something in them you can admire; trust them enough to be friendly; remember that people want to like you and that most of them are kindly. Build up your self-respect; do something to earn it, if need be. Try to share what you have enjoyed and this will keep you from worrying about yourself.

Develop poise by practising self-control. Take time to think before you move or speak, and you will not make awkward blunders. When you catch yourself fidgeting and doing annoying things, such as tapping with a pencil, playing with table silver, or toying with something you are wearing, drop your hands in your lap. Relax your muscles, without slumping.

Since a knowledge of etiquette will give you more self-assurance, find out from books and from watching well-mannered people what is expected of you in various situations. But do not forget that charm depends on common sense. For example, a polite boy stands back to let a girl or some older person pass through a

door ahead of him. But when he is near the door in a crowded elevator, he will step out quickly and get out of the way. A boy rises whenever a girl or woman gets up from her chair or when she comes into the room; but it is not practical to observe this courtesy constantly in the schoolroom. So too when a girl in her own house is serving refreshments, it would be foolish for the young men present to rise whenever she leaves or enters the room.

Two further suggestions for cultivating charm are: learn to observe; and do not pretend to be something you are not. Some persons do unpleasant things without knowing it, because they do not take the trouble to watch for the signs that show the feelings of others. Those who try to make others think that they live in a grander way than they do, or who boast of fooling their teachers, earn the unpleasant name of "show-offs." They are like the haughty Countess Gruffanuff in Thackeray's 'Rose and the Ring', who put on such airs that "all sensible people laughed at her absurd pretensions."

Manners at Home

Those with charming manners have acquired them by practising them every day in their homes. Courtesy has become a pleasant habit, and such persons do not have to be uneasy about their manners in any company.

First comes deference to the older people. Well-bred young people rise and offer their mother the most comfortable chair when she enters the room, just as they would do to a visitor. They help her with household chores. They get the newspaper for their father. They reply politely, "Yes, Mother," and "No, Father," not peevishly, "Wha-a-t?" or "Naw."

Respect for others' belongings is another courtesy first learned at home. A boy has no right to take his brother's skates without permission; a girl is not fair if she grabs her sister's raincoat as she starts out, because she cannot find her own. For reasons of hygiene as well as of etiquette, no one uses another's comb, brush, powder puff, or towels.

Even with members of his own family, the courteous person will refrain from such liberties as opening another's bedroom door without knocking and waiting for a response; bursting noisily upon one who is reading or playing the piano or talking; or making a joke in company at the expense of a brother or sister.

Sarcasm and cheap humor in the family circle are very bad manners. Instead of saying "Thank you," a girl sometimes says to her brother who has shown her a special courtesy, "You must want me to do something for you," or "Are you sick?" Such remarks are not funny and discourage further thoughtfulness. Family bickering is not heard in homes where tolerance, gentleness, and self-control are cultivated.

The dinner table is the center of family social life and provides a good training-ground for learning etiquette. Everyone should come punctually to meals. All should be neatly dressed—the men and boys with coats and collars on, the women and girls without hair curlers or aprons. One of the boys should draw his mother's chair out for her. If it becomes necessary to leave the table before all have finished, permission should always be asked of the head of the family. Only pleasant subjects should be discussed—books, sports, amusing incidents, news—and all should be given an opportunity to take some part in the conversation.

In Street and Corridor

Well-bred persons in the street, an auditorium, or other public places, do not interfere with others' rights or draw attention to themselves. Boys and girls who talk loudly and giggle in public, push one another about noisily, or wear gaudy clothes are consciously or unconsciously trying to attract attention. Such behavior is a sign of childishness and lack of experience.

Other inconsiderate and rude kinds of behavior are these: carelessly bumping into people; swinging or carrying an umbrella so that it may hit someone else; strolling down the street in threes or fours so that others are forced out of the path; sprawling in the seat of a bus or street car; stretching the feet into the aisle for others to trip over; squeezing in ahead of others in line at a ticket window; tossing trash into the street, park, or school yard; pell-mell rushing or gathering in a knot in street or hallway.

If two or more persons meet in street or corridor and wish to talk, they can walk together for a while or at least step to one side. A boy will, of course, walk in the direction a girl is going.

It is a girl's place to speak or bow first when she passes a boy she knows. If the two are good friends and the girl has not happened to see him, the boy may greet the girl but never by calling loudly to her. No one should call out a friend's name in a public place. Nor is it polite for a boy to stand in front of a girl's house and whistle or sit and honk an automobile horn for her.

When a boy is with a girl in the street, he walks on the side nearer the curb. This custom goes back to days when there were no sidewalks and the cleanest and safest place to walk was as close to the buildings as possible. If a boy is with two girls, he still belongs on the outside and not between them.

These are some of the courtesies expected of a man or a boy: He lifts (do not say "tips") his hat when he speaks to a woman or she speaks to him; when someone with him greets a woman; when he meets or leaves a woman; and when a woman with him speaks to a passerby. He takes off his hat when he enters a room or a hotel or club elevator in which there are women. He does not wear a hat in a house or school building. He rises when a woman comes into a room or when she rises from her chair, and stands until she is seated. He waits for a woman who is with him to enter a vehicle, but he precedes her in stepping out so that he can extend his hand in helping her to alight. He offers to carry a bundle or book for her, but a thoughtful girl will not allow him to carry her jacket or small girlish-looking packages.

A girl should give a gracious "Thank you" to one who offers her a seat, picks up her paper, or holds a door open for her. She will not expect a man of her acquaintance who happens to enter a street car or a bus with her to pay her fare, but if he does so, she will not protest against so small a favor.

In Theater and Restaurant

In assembly hall, church, theater, and other gathering places one should avoid unnecessarily passing in and out in front of people; arriving late and leaving early; laughing and talking during lecture, play, or concert; putting the feet on the seat in front; applauding at the wrong time or noisily or too long; rattling papers; tapping the feet or humming when there is music; crunching nuts or munching chocolates during a performance. A girl wearing a large hat must remove it for the sake of those behind her.

When a young man enters a restaurant or confectioner's shop with a girl and there is no waiter to conduct them to a table, the man leads the way, chooses a table, offers the girl the preferable seat, and pulls out her chair for her. If a waiter leads the way to the table, the man walks at the girl's side or just behind her. The man gives the order after consulting the girl. A thoughtful girl will consider her host's means in deciding what she will have but will not make him feel that she is stinting herself. The tip should be about ten per cent of the bill, or somewhat more if the service has been exceptional or much service has been required.

In Any Public Place

It is crude to address strangers as "Miss," "Lady," or "Mister." If it is necessary to use a title for someone whose name you do not know, say "Madam" or "Sir." It sounds more sincere to say "I'm sorry" if you inconvenience a person than to say pompously, as many do, "Pardon me." When you must pass in front of someone, say "Excuse me."

There are unsightly acts that no considerate person will perform in public. Gum chewing is one. The faces a chewer makes are not attractive; the sound of chewing is not pleasant; and the odor of gum is offensive to many. Spitting is both unsanitary and repulsive. In blowing the nose, the handkerchief should be used quietly and inconspicuously. Digging into the ears and clearing the throat loudly are as uncouth as scratching. Cleaning finger nails in public is no more excusable than brushing the teeth at a public fountain would be. These operations, like hair combing, are part of one's toilet and should be attended to in private. Girls should do their primping in bedroom or dressing room for the same reason.

How to Make Introductions

When you introduce two women or two men to each other, address the older one or the one in higher official position first. For example, speak to your teacher first in introducing a new pupil. "Miss Marks, this is Helen Fry." Address your school principal first in introducing your father—"Dr. Southern, my father"—unless your father is considerably older. When the two persons are of the same sex and about the same age, it does not matter whose name you give first. But in introducing a man and a woman or a boy and a girl, the woman or girl must be addressed first, unless the girl is very young and the man elderly or distinguished. Introducing two of your older sister's friends, you might say, "Miss Cape, do you know Mr. Mantle?" With your schoolmates, you would be less formal, "Freda Bay, Carl Hyde." You introduce a new school friend to your parents at the first opportunity. "Mother, I want to introduce Carol Dane to you" or "Father, this is Harold Hunt."

Many forms of introduction are used, but the names alone are sufficient if said graciously. Be sure to pronounce them distinctly. Commands like "Meet Miss Smith!" and "Shake hands with Bill Brown!" are not polite. "Let me make you acquainted with" is bad English and bad form. "May I present" is too pretentious for any except extremely formal introductions.

You may respond to an introduction with "How do you do," or "How do you do, Mrs. Brimm." Do not say "Pleased-to-meet-you." If you are introduced to someone you have heard about, you may say, if it is true, "I've wanted to meet you" or "Jack has told me about you."

Boys and men when introduced to each other rise and shake hands. When introduced to a girl, they rise, but they let the girl decide whether or not to shake hands. A girl need not rise when a boy or another girl is introduced to her. She does rise when she is introduced to an older woman or to anyone in her own home; also when a much older man is introduced or whenever the introducer is an older woman. A young girl will not take the lead in shaking hands when introduced to an older woman.

When an introducer adds a few words after an introduction, it is easier for two people to start a conversation. "Donald has just been transferred from Central High," "Eve skates as well as you do, Jack." Whoever thinks of something appropriate to say after an introduction may say it, but young people usually let older persons open the conversation.

When two persons have met and talked for a while, one may say upon leaving, "I am glad to have met you." The reply to such a compliment may be merely "Thank you," with a smile, or perhaps "I hope I'll see you again"—whatever seems natural.

Entertaining Guests

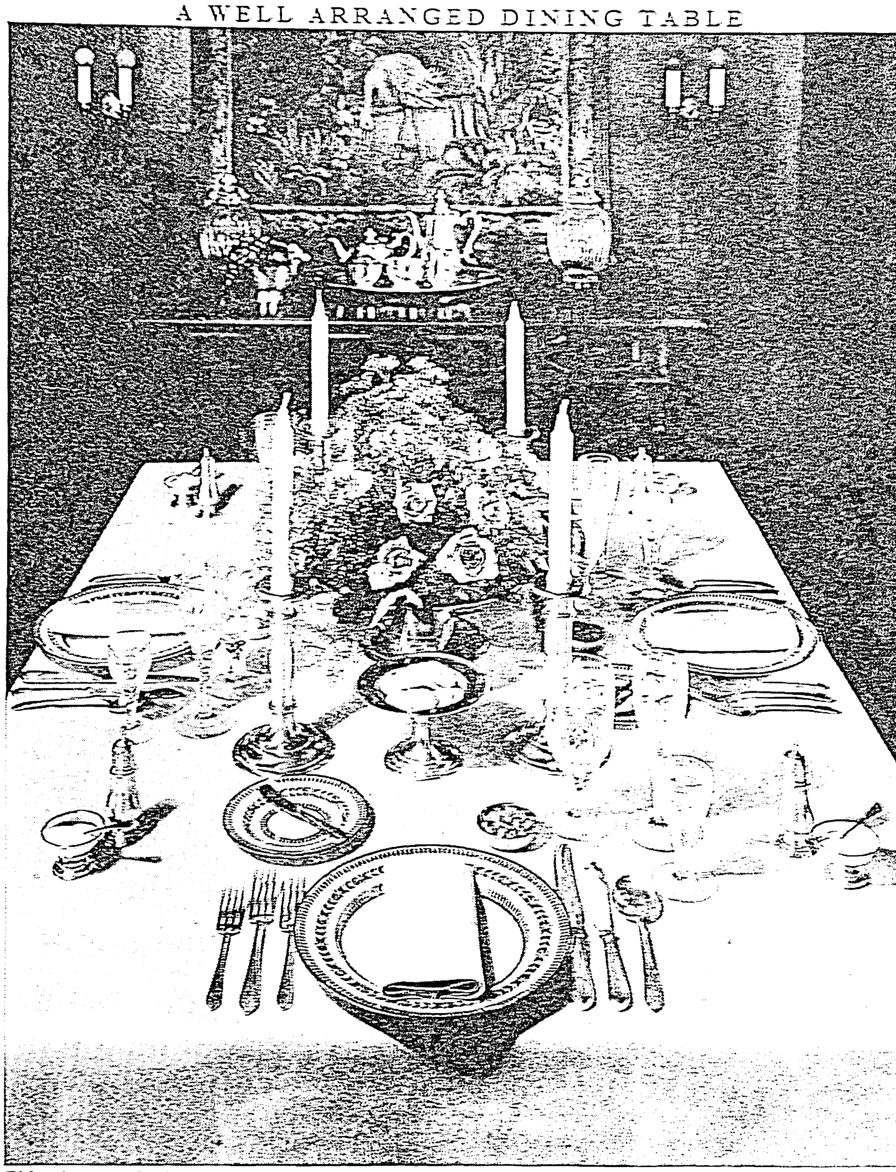
When you have guests, your wish is to give them pleasure and make them feel at home. You will see that they have comfortable seats and anything they may need; and you will lead the conversation to topics which are of interest to all. It is rude to talk with one guest about happenings the others know nothing about, so that they feel left out. Your mother, because she is the real hostess, will make a point of greeting your friends who come to the house, even though you may be going out with them at once. If your father is at home, he will like to speak to them, too.

Visits of several days made by younger high school

girls and boys to one another's homes are arranged by their mothers. Older boys and girls may write an invitation in their mother's name; for example: "Mother wishes me to invite you to spend Fourth of July week-end with us. Can you come Friday afternoon and stay until Monday morning?"

The young person who is expecting a visitor will not leave all the preparations to be made by his or her mother. A girl will see that the guest room is ready—fresh linen on the bed, a fresh scarf on the dressing table, and hand towel, bath towel, and wash cloth laid out for the visitor. The young host or hostess will see that the guest has an opportunity to do the things he or she likes to do and will not plan pastimes just for his own pleasure. Most visitors especially enjoy the amusements they do not have at home.

A WELL ARRANGED DINING TABLE



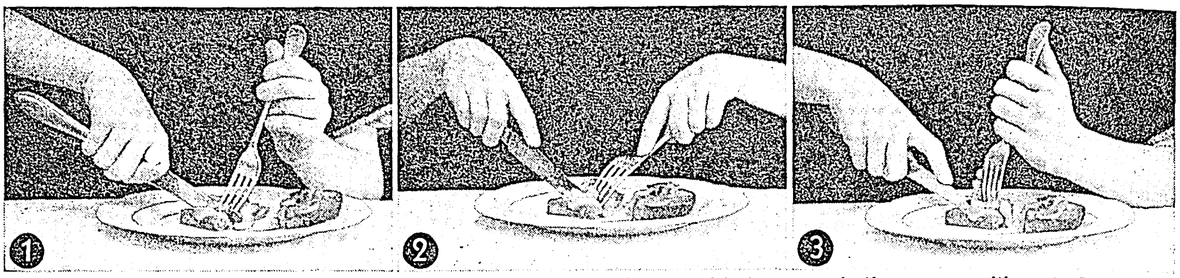
This photograph shows a completely set table, with plates, silver, glasses, napkins, salt cellars, and pepper shakers in their proper positions. The forks are arranged in the order in which they will be used. Notice the simple and effective way the napkins are folded. Butter plate and butter knife have been included here to show their proper placement on the table, although these would not be used for a strictly formal dinner.

Being a Guest

The visitor who goes calling should choose suitable hours and should leave before meal time approaches. He should find out whether his stay is interfering with the plans, habits, or wishes of the family. The house guest who will be invited again is the one who is prompt in coming to meals; accepts the customs of the household cheerfully; is polite to all members of the family; does not forget to bring necessary toilet articles; helps when possible with household duties without getting in the way; does not urge son or daughter to do something against the parents' wishes; does not use a towel for a shoe polisher or in any other way damage the belongings of the house; makes as little trouble as possible; does not stay beyond the time set; and does not go away leaving garments or articles which will have to be forwarded later. A girl takes care of her room if there are no servants or only one; a boy does not leave clothes and shoes scattered around his room.

Guests may take a gift to their hostess or young friend or both, though this is not the only way to show appreciation. It does not look well to send a gift immediately after the visit, as if offering a payment for hospitality. A guest does not fail, however, to write a letter of appreciation both to the hostess (the mother of the family or whoever takes her place) and to the family member on whose account he or she was invited, within a few days after returning home.

RIGHT AND WRONG WAYS TO HOLD KNIFE AND FORK



1. This is wrong. The knife is gripped in the fist and the fork is held tines up with the fingers in the wrong position. 2. The correct way. 3. Children often hold knife and fork this way before their fingers are strong enough for the correct method.

This is called a "bread-and-butter letter." It may be brief, but not stilted or formal. It is well to recall some specially enjoyable feature of the visit.

Behavior at Dances

When a young man invites a girl to a dance, he dances the first and last dances with her and one or two more, at least. He introduces to her his friends, who, if they are polite, will then ask her to dance with them. He keeps an eye out for her to see that she is not left without partners and that she is not embarrassed by having to dance with one partner for too long a time.

When the cutting-in plan is followed, a boy goes up to a couple on the floor, touches the boy on the arm, and asks if he may cut in. He has, of course, been introduced to the girl, or a friend comes with him and introduces him. The girl's first partner thanks her for his dance, and she says, "I enjoyed it" or something else pleasant. He does not cut in again until she has another new partner.

A man never leaves a girl alone on the floor at the end of a dance. If someone else does not claim her, he takes her to a seat near friends or wherever she asks to be taken. If no one cuts in for a long time, the boy may make his partner more comfortable by stopping and introducing one of his friends to her.

When arriving at private parties, guests speak to the hostess as well as to the son or daughter or visitor for whom the entertainment is given; when leaving, they seek out the hostess and mention the pleasant time they have had. When chaperons act as hostesses at school parties, they are thanked for their part in the affair. Girls or boys who planned the entertainment pay the chaperons the courtesy of introducing their guests to them.

Boys and Girls

Friendships between boys and girls are jollier when both take care to learn what is fitting in social life. Young people should realize that a boy and girl who sit by themselves during a party or dance together continuously are being rude to others in the group. Each should be too considerate of the other to urge any action that would bring family disapproval or would be an infraction of school rules.

When a boy pays a girl an attention, such as inviting her to a ball game or a dance, she does not thank him for the entertainment as if he had done her a favor, but she does let him know that she appreciates his courtesy. She may say when they part, "I have had a good time this afternoon," but her good spirits and interest have shown her enjoyment long before. When a girl is with a young man, she should let him take the lead in attending to arrangements and not be too quick to take matters into her own hands or do things for herself. If her escort does not know what courtesies are expected of him, she can often, without appearing to criticise, give him a suggestion; for example, "Will you hold my coat for me, please?" when she starts to put on her wrap.

A boy who wishes to give a girl a present will select something simple—candy, a book, a photograph album, flowers. It is in bad taste for him to offer presents or entertainment that he cannot afford, and a well-bred girl will discourage his doing so. She will prefer violets he has picked in the woods or a few garden flowers to extravagant purchases.

Games and Good Sportsmanship

Many believe that there is no better way of judging a person than by playing a game with him. The "poor sport" lacks both manners and character. Good sportsmanship calls for fair play; strict observance of the rules; acceptance of victory without crowing, and of defeat without ill humor. It is poor sportsmanship to make many excuses for losing; to try to rattle players on the opposing team by jibes; to put the blame for defeat on a partner; to accuse the referee of unfairness; to ask to be let off a penalty because "you didn't know it was against the rules." Politeness suggests that visitors be allowed first turn in a game; and boys give girls this privilege if the rules permit. In any game, one who unasked tries to teach others is usually unpopular. Those who let their animation become rowdiness are ill bred.

Setting the Table and Serving the Meal

A table is set with the knives and spoons on the right side of the service plate and the forks on the left, except the oyster fork, which is placed with the spoons. The piece of silver first needed is put farthest from the plate, and others in the order in which they will be used. The dessert silver is not put on the table until needed. The glass is at the head of the knives; the bread-and-butter plate at the head of the forks. The butter knife ("butter spreader" is not polite usage) is laid across the bread-and-butter plate

with the handle toward the user. Napkins are laid on the service plates. Candles in tall candlesticks may be set on the table when artificial light is needed. Doilies and runners may be used for breakfast and luncheon, but a tablecloth should always be laid for dinner.

Properly, the napkins are on the service plates at the start of the meal, but when a hostess is doing her own serving, she will have the first course —possibly grapefruit, fruit or fish cocktail, or soup—in its container on each service plate when the guests come in. The napkins are then laid on the table beside the forks. Service plates are never used after the soup course.

Approved service today requires that dishes of food be kept off the table. The meat, already carved, and the vegetables are handed around for each guest to help himself.

The woman at the right of the host is served first, hers being the place of honor. Service proceeds around the table clockwise. The practise of serving the hostess first so that she may see that the dish has been properly prepared is giving way to the politer custom of offering food first to a guest.

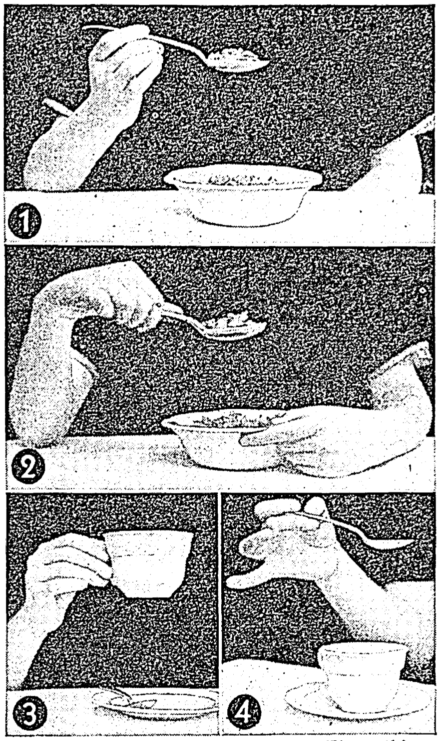
As each used plate is removed at the end of a course, a fresh one for the next course is put down. Plates for hot courses are heated. The approved practise is to have only one plate removed or brought in at a time. A tray is used only for the sugar and cream served with coffee or berries.

The hostess who has no maid can simplify service and still not clutter up her table with food or keep her guests busy passing dishes or commit the atrocities of stacking and scraping dishes at table. She can have at her right a serving table and set the main course dishes on it after handing them (her daughter may do this), to have them near if she offers second helpings. She may even serve the plates from this table. Plates filled in the kitchen, tea-room style, are not as appetizing as they might be. Two dishes at a time may be removed, when there is no servant, and relishes may be set on the table. Other short cuts which do not spoil the appearance of the table or seem slovenly may be employed, such as putting the salad on the table with the main course.

Whether a meal is elaborately served with butler and footman, or served simply with no servant, service should be quiet, with no feeling of hurry. The servantless hostess will plan to get up from the table only a few times and will not attempt to entertain a large number for dinner.

All dishes are offered and plates removed from the left side of the person who is being served. Coffee cups are set down at the right and glasses refilled on that side. A question of service can be decided by asking oneself what method will cause the diner the least inconvenience.

HANDLING SPOON AND CUP



1. The right way to hold a spoon. 2. Three things are wrong here: the spoon is held in the fist, the right elbow is on the table, and the left hand is holding the dish. 3. Correct way to hold a cup. 4. This affected way of extending the fingers in handling spoon, fork, or cup is to be avoided.

Before the dessert course, everything is removed from the table except glasses and nut dishes. As each dinner plate is removed a dessert plate holding a doily, a finger bowl half filled with water, and a dessert spoon and fork is substituted. The guest slips the doily and finger bowl onto the table near his plate. He may put the dessert spoon and fork one on each side of his plate. The dessert is then passed, and each person helps himself. If there is no maid, the hostess sometimes serves the dessert plates at the table, or the plates containing the dessert are served from the kitchen. After-dinner coffee in small cups may be served at table with or following dessert, but a popular custom is for the hostess to pour it in the living room after the meal.

Manners at Table

All rules for eating have reasons back of them which you can usually figure out for yourself. For example, when cutting meat, we hold a fork loosely with the first finger pointing downward on the back of the handle, instead of seizing it as if it were a pitchfork. The knife is held in the same flexible way. When you have cut a piece of meat, you can sensibly take it to the mouth with the fork still in the left hand, tines down. This is the older American and European custom which is now rapidly returning. Or you may lay your knife on the plate and transfer the fork to the right hand, tines up, before carrying the food to the mouth. Do not be hasty; and never cut more than one piece of meat at a time. Whenever vegetables or foods not cut with a knife are eaten, the fork is held in the right hand, tines up. When not in use, knife and fork are laid side by side across the plate, not propped against the edge, possibly to slip to the table or drip grease on the cloth.

The knife is used for cutting only. Spoons are used for liquids, cereals (dessert spoon), some desserts, and a few other purposes, but never for vegetables. For these, use a fork only. But do not do any of the

following things with your fork: pile vegetables on the tines on top of a morsel of meat; take more food on it than you can eat at one bite; hold it filled with food on the way to your mouth while you talk; use it to make hills and valleys of your food.

Among the few foods that have to be eaten with fingers are olives, potato chips, burr artichokes, corn on the cob, and ordinary sandwiches; it is better, however, to cut sandwiches in halves before taking them in the hand. Peaches, apples, and similar fruits are pared, then cut into small pieces, and eaten with the fingers. After eating, one dips the fingers, of one hand at a time, in the finger bowl. Well-bred persons will not take up bones in the fingers except small ones of chickens or birds, and then only when the occasion is very informal.

Fruit pits are taken from the mouth in the cupped hand and dropped on the plate as unnoticeably as possible. Cooked fruit pits may be taken from the mouth with a spoon. A fish bone may be drawn from between the lips with the fingers. Rather than hide your face behind a napkin while you remove some tenacious object from your mouth, it is better to excuse yourself from the table for a few minutes. The white flag method makes a person unpleasantly conspicuous.

Bouillon is first sipped from the spoon, then drunk from the cup. Soup is drunk from the side of the spoon, and the spoon is dipped away from one to prevent dripping. Coffee, tea, or other beverages are not sipped from the spoon at any time. The coffee spoon is laid on the saucer, not left in the cup, possibly to be knocked over.

Other Details of Table Manners

When you sit down at the table, you immediately take up your napkin. Do not unfold a large one completely, but lay it across your knees folded once or twice, according to size. Lift only a corner to your mouth. If you are a guest, you need not refold your napkin at the end of the meal. Push it neatly under the edge of your plate as you get up, but not before. A used and crumpled napkin is not a pretty sight for those at the table.

Never butter a whole slice of bread and bite into it, leaving teeth marks. Break off a small piece, butter it, and then eat it. Other table practises to avoid are these: blowing on food or liquid to cool it; lolling with elbows on the table; saying rudely, "I don't like that," when a dish is offered. You can take a little of the food on your plate, even though you do not intend to eat it. If many dishes are served, you may refuse one with a "No, thank you," without fear of worrying your hostess. If you want a second helping and it is offered, do not hesitate to take it.

Perhaps the worst manners at table are eating with the mouth open, swallowing noisily, gulping water, and gobbling food in large mouthfuls. These actions suggest that the eater is thinking more about his appetite than about the company he is in.

If you are in doubt about what to do at the table, you can usually look around and see what others more experienced are doing. If you follow your own judgment as to what is natural, convenient, and unlikely to offend, you are not likely to go far wrong.

Some Principles of Dress

George Washington when a young man copied a set of "Rules of Civility" to guide his conduct. (Some of these may be found on page W-14). They are just as sound today as when they were written. One of the rules about dress says: "In your Apparel be modest... Keep to the Fashion of your Equals such as are civil and orderly with respect to Times and Places." Long before, however, Shakespeare had expressed the importance of this phase of etiquette when he made Polonius say, "The apparel oft proclaims the man."

Care about one's appearance shows a regard for others and a respect for oneself. And the assurance of being well-dressed gives self-confidence. Here are some of the things that well-bred people are most particular about: clean faces, finger nails, teeth. underwear, outerwear, and handkerchiefs; clean, neatly arranged hair; well-polished shoes; and unwrinkled stockings.

Dressing for dinner is a custom which has come about, because freshening the appearance tends to freshen the mind too and to put one in a more sociable mood. Even washing the hands and brushing the hair help, and no one should fail to do at least this much before coming to the table.

The first principle of being well dressed is to be suitably dressed—to consider, as Washington said, "times and places." A girl in a velvet or ruffly dress at school looks as much out of place as a boy in overalls would at a party. On a rainy day the well-dressed person wears clothes intended to stand the rain. A fancy hat does not go well with a tennis costume. Some noticeable inappropriatenesses are high-heeled sandals for walking or school; many pieces of jewelry; harshly colored ties; highly scented perfumes. Young girls should avoid conspicuous make-up, for their greatest charm lies in their freshness.

What to Do When Traveling

The good traveler goes his way quietly, does not put others out, does not make fun or complain of unfamiliar customs, and does not deface property with his initials or damage it to collect souvenirs. Only those with little knowledge of the world feel that they must talk with their seat mates in bus or train. If by chance an incident leads to conversation, the well-bred person does not allow it to become personal and is slow to suggest an exchange of names.

A young woman traveling alone will be very careful about encouraging any attentions on the part of a man, because her attitude may be misunderstood and lead to embarrassment for her. She will not let a man who happens to be thrown with her on a trip pay for her meal. She can say, "I think I'll dine later on," or "Thank you, but I'd rather pay my own check." It is a mistake in traveling to seek information from a stranger. Train conductors, station agents, and other authorized persons are the ones to consult.

A woman or girl spending the night in a sleeping-car usually undresses in the berth before going to the dressing room in pajamas and robe or kimono. Some prefer to change in the dressing room, if it is not crowded. It is important to stay in the dressing room only a short time, to take up as little room with bag, clothes, and toilet articles as possible, and to leave basin and shelf tidy. It is best to take only a small case, or, lacking that, to gather up one's toilet necessaries in a towel or cloth bag.

When the Pullman porter offers to brush one off near the end of the trip, he is usually given 50 cents for a night trip; for a day trip, 25 cents.

Proper Procedure in a Hotel

A young girl does not stop at a hotel unchaperoned unless some circumstance makes it unavoidable. She remains in her room while in the hotel unless she is seeing visitors in the reception rooms or having a quiet meal in the dining room. In a hotel dining room a woman wears her hat unless she is in evening dress.

As soon as people arriving at a hotel have made inquiries about a room, they register. A woman writes "Miss Eve Garden" or "Mrs. I. M. Adam" since this is not a signature, but an identification only. A man registers "I. M. Adam," or, if he is with his wife, "Mr. and Mrs. I. M. Adam." Many hotels now use individual registration cards. On these you write your street address, as well as city and state, but in a desk register you omit the street and number unless they are required.

The bellboy who takes the baggage up to the room expects a tip of 15 or 25 cents. For other services, such as calling a taxi or delivering a package, he usually gets 10 cents. The fee for the chambermaid is usually left in the room, the amount depending upon the length of one's stay—perhaps 50 cents for three or four days' service.

When ready to leave a hotel, ask the cashier for your bill, and when you have paid it, get the clerk to send a bellboy for your bags. Or you may have the bellboy bring your bags down and wait while you pay the bill. If you wish, he will call a cab for you and put your bags in it. For this service, give him 25 cents. The tip to the cab driver for a short haul may be 10 or 15 cents. Customs in tipping vary widely from place to place. It is a sensible practise to inquire about them from friends when visiting a strange city.

Since etiquette plays such a large part in our relationships with others, it frequently comes up in works of fiction, as well as in essays. In the chapter of 'Lorna Doone' entitled "Squire Faggus Makes Some Lucky Hits," you will find something about manners in eating; in "Prodigal's Return" in 'Pendennis', an account of a girl's opinion of a young man's manners; in Chapter XXX of 'Little Dorrit' a description of a rude, greedy man, Monsieur Rigaud. Other references are "The Smile" in 'Glimpses of Unfamiliar Japan', by Lafcadio Hearn; etiquette of the South before the War Between the States in 'Social Life in Old Virginia', by Thomas Nelson Page; "Manners" in Emerson's 'Essays' and the chapter "Social Aims" in 'Letters and Social Aims', by the same author; and 'The Professor at the Breakfast Table', by Oliver Wendell Holmes. The following books give helpful advice on etiquette problems: 'Vogue's Book of Etiquette'; 'Etiquette', by Emily Post; 'This Way, Please', by Eleanor Boykin; 'It's More Fun When You Know the Rules', by Beatrice Pierce (for young girls); and 'The Correct Thing', by William Oliver Stevens (for young men).

ETNA, MOUNT. Two hundred miles almost due south of Mount Vesuvius, on the eastern coast of the island of Sicily, towers the "burning mountain" of Etna. It is older than Vesuvius, much higher, and grander though less frequent in its eruptions. More than 80 eruptions of Etna are on record, the earliest about 479 B.C. In 1169 A.D., 15,000 inhabitants of near-by Catania were destroyed, and again in 1669 some 20,000 perished. In the last hundred years there have been more than a dozen major eruptions. The great eruption of 1892 lasted six months. The eruption of 1928, while less violent than many others, caused an immense amount of damage.

In spite of these terrors, villages and farmhouses nestle close on the broad expanse of Etna's flanks. The rich soil formed from old volcanic eruptions tempts people to take advantage of its fertility. The mountain rises through three zones. First comes the cultivated region, to about 2,000 feet, where date-palms, bananas, oranges, lemons, olives, figs, and almonds are grown. Next is a wooded region, planted with forests of chestnut, cork, beech, pine, maple, and oak. This contains a famous chestnut tree, one of the largest and oldest trees in the world, formed by seven trees grown together and 163 feet in circumference. At about 6,300 feet from the base of the mountain begins a dreary waste of black lava, ashes, and sand, covered through a large part of the year with snow. A volcanic observatory 9,075 feet above the sea was built in 1880. This is the highest inhabited house in Europe, being 1,000 feet higher than the shelter on the Great St. Bernard in the Alps. A fine highway leads from Catania up to the lava fields.

The summit of Mount Etna is about 10,750 feet above the sea, and its base is 90 miles in circumference. A considerable part of the world's supply of sulphur is gathered from the craters. The Sicilians call the mountain "Mongibello," a corruption of the Saracen *Jebel Uttamat*, "mountain of fire."

ETRUS'CANS. Long before the days of Rome's greatness, Italy was the home of a people far advanced in civilization and culture—the Etruscans, or Tyrrhenians as they were called by the Greeks. This "riddle race" of Italy rose to prosperity and power, and then vanished completely from the stage of history, leaving unsolved many problems concerning its origin and civilization.

The Etruscans taught Rome much of her art and science, they gave her many of her social, religious, and political customs and institutions. Their blood mingled with that of the warlike Romans and still flows in the veins of the Italians of today. But their history is like a book that has been written and erased. Their literature has practically disappeared; the language of their inscriptions has been only partially deciphered; and only in the few remains of their

ancient buildings and monuments,—most of all in their tombs,—can we read their puzzling but fascinating story.

As we see them in the paintings on the walls of their tombs, the Etruscans were a short thickset people, fond of rich garments of graceful lines and bright colors. Their religion was somber and mysterious, and they dwelt much on the life after death; but they were fond of good living, games and amusements, dancing, music, and the theater. The women were noted for their rich jewelry; golden wreaths and coronets, brooches of delicate filigree work, long earrings, massive necklaces and bracelets, rings of beautiful design and many other articles of adornment, together with mirrors of polished bronze, have been found in their tombs.

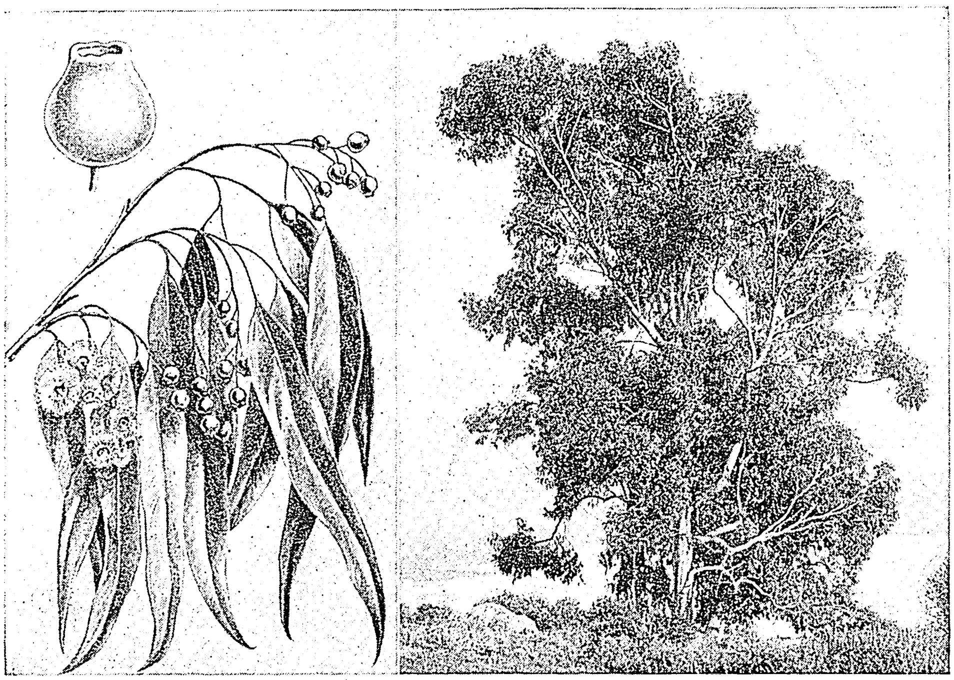
Weapons and other implements, beautiful vases, and statues of stone, bronze, and terra cotta show that the Etruscans were skilled artisans. But they had little originality, most of their work being imitated from that of the Greeks.

It is thought that the Etruscans were a seafaring people from somewhere in or near Asia Minor. As early as 1000 B.C. we find them settled in Italy, between the Arno and the Tiber, in the district which corresponds roughly to modern Tuscany. At one time their rule embraced the greater part of Italy, including Rome. When the Tarquins were expelled from Rome, about 500 B.C., Lars Porsena of Clusium sought in vain to reëstablish the Etruscans.

Driven from Rome, the Etruscans sought power in other fields. They already controlled the commerce of the Tyrrhenian Sea on their western border, and now they strengthened their naval power by means of an alliance with Carthage against Greece. But in 474 B.C. their fleet was destroyed by the Syracusans, and from then on their power rapidly declined. The Gauls overran their country, and their strong southern fortress of Veii fell to Rome after a ten years' siege (396 B.C.).

EUCALYP'TUS. Next to the Douglas fir and the giant redwoods of California and the American northwest, the tallest tree in the world is the *Eucalyptus regnans*, or mountain ash, of Australia. The largest one ever measured was 346 feet high. The tallest Douglas fir measured 380 feet, and the tallest redwood between 359 and 368 feet. All the eucalyptus family are valuable gum trees. Their tall white stems often rise 60 or 70 feet above the ground without a branch. This group includes more than 350 species, ranging from such giants down to the small eucalyptus bushes so common in California, and they rank among the most beautiful and useful of trees.

THE GIANT TREE THAT GROWS FROM THE PIGMY SEED



The giant eucalyptus tree grows from a seed so tiny that several hundred would scarcely fill the palm of your hand. These marvelous little seeds mature within the tree's cuplike fruit, shown at the top of the picture on the left. Below you see the fruit, flowers, and leaves as they grow on the tree. The eucalyptus tree at the right is of the kind known as the "Red Gum."

The wood is very tough and durable, and is much used for ship- and wharf-building because it resists decay in the water. It takes a high polish and so is valuable for interior finishing. Certain eucalyptus trees yield a gummy sap, from which tannin is obtained. The inner bark of some species consists of very tough long fiber, used for rope-making, paper, and thatch. The leaves, which in many species turn edgewise to the sun, furnish the eucalyptus oil (eucalyptol) used in medicine for its germ-killing and stimulating properties.

The name eucalyptus comes from two Greek words meaning "well covered," referring to the abundant foliage. Because this enormous leaf area enables them to evaporate into the atmosphere the vast quantities of water absorbed by their roots, eucalyptus trees are often planted in swamps, which they help to drain. It is this faculty for drying up mos-

quito marshes, rather than their pungent odor, which has won for them their reputation as safeguards against malarial mosquitoes.

The eucalyptus genus belongs to the family of myrtles. Among the most common species of the eucalyptus are the blue gum, valuable for its timber; the manna gum, valued for the nectar of its white blossoms, of which bees are very fond; the jarrah tree, most used for ships and docks; the peppermint tree, noted for its oil; and the swamp mahogany, best reclaimer of swampy lands. The tree makes itself at home in California where 70 species have been adopted for their beauty and utility. Rows of eucalyptus along the Central Pacific railway lessen droughts. In Texas, the blue gum is planted to drain swamps.

EUGEN'ICS. Two thousand years ago Plato asked: "If care was not taken in the breeding, would not your dogs and birds greatly deteriorate? And what if the same principle holds of the human species?" Today we are asking the same question.

Eugenics as a science dates from the last quarter of the 19th century, when the term was coined by Sir Francis Galton in his book, 'Inquiries into Human Faculties'. He defined the science as "the study of the agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally." Practically, this simply means control of the unfit—the feeble-minded, diseased, and criminal—most of whose children sooner or later become wards of the state. Segregation of the feeble-minded and those otherwise physically unfit is much advocated, and is an increasingly popular method of dealing with the problem. (*See* Heredity.)

EUPHRATES (*ū-frā'tēz*) **RIVER.** Next to the Nile the Euphrates, which is the largest river of western Asia, is probably the best-known stream in history. It rises in the heart of Armenia and flows south, breaking through the Taurus Mountains in a succession of rapids and cataracts for about 40 miles. At Korna the Tigris joins it, and with the new name of Shatt-el-Arab it empties itself by several arms into the Persian Gulf, 1,800 miles from its source.

It is navigable for small boats nearly 1,200 miles and steamboats ascend it for 100 miles to the junction with the Tigris.

In ancient times, by a system of canals and embankments, the river was used for irrigating the country as the Nile is in Egypt, but the works were not kept up. Today there is little to suggest the fertility and culture of 5,000 years ago (*see* Mesopotamia). The Euphrates is mentioned in the Bible as one of the four rivers of the Garden of Eden. It is called the "great river." The city of Babylon was situated on its banks, and Nebuchadnezzar had locks and dikes made to enable large vessels to ascend it as far as the city.

The MOTHER LAND *of the* MODERN WORLD

Extent.—North to south, 2,400 miles; east to west, 3,000 miles. Area estimated at about 3,900,000 square miles. Population, approximately 530,000,000.

Mountains.—Northern system, including mountains of Scotland and Scandinavia (highest point, 8,399 feet); southern system, including Pyrenees, Alps, and Carpathians, with Apennines and Balkans as offshoots (highest point, Mt. Blanc, 15,782 feet). Ural Mountains (highest point, 5,537 feet) and Caucasus Mountains (Mt. Elbrus, highest peak in Europe, 18,465 feet) separate Europe from Asia.

Rivers and Lakes.—Chief rivers: Rhine, Elbe, Oder, Vistula, Dvina, and Pechora flowing northward into the North Sea, Baltic or Arctic Ocean; Rhone, Po, Danube, Dniester, Dnieper, and Don flowing south into the Mediterranean, Adriatic, or Black Seas; Volga and Ural flowing south into the land-locked Caspian Sea. Largest lakes: Ladoga (about as large as Lake Ontario), Onega, and Peipus in Russia, with numerous smaller lakes in Sweden, Finland, and the Alpine region.

EUROPE. The continent of Europe looks as though it had fallen into the Atlantic Ocean in a mad scramble to escape from Asia by the back door, and was threshing about with as many arms and legs as a centipede. Russia thrusts itself northward and is doubled back by the Arctic to form Sweden and Norway. Denmark almost breaks away from Germany. Holland (the Kingdom of the Netherlands) fairly plunges under the ocean. France and Spain shoot out southward and westward, stopping at Gibraltar just nine miles short of running head-on into Africa. Italy has kicked itself almost free and is ready to step out on Sicily. Greece and the whole Balkan peninsula are only stopped by narrow waters from blindly rushing again into the arms of Asia. The British Isles alone have made good their escape and put the Channel and the North Sea between them and recapture.

Everywhere the ocean waters run in and fill the lowlands with bays and gulfs and inland seas. Ranges of mountains stand out like knotted muscles on this struggling land-mass. The confused tongues of 60 different languages proclaim the same truth as the map—that Europe is a continent of physical or racial diversity. It is the continent of contrasts and conflicts, of glorious variety, and of life-giving progress. "Better fifty years of Europe than a cycle of Cathay," for Europe is truly the center of the modern world. Packed into Europe's small compass are more great nations than you will find in all the rest of the world put together. By a series of railway or steamboat journeys, each only a few hours long, you may hear a different language every day for several weeks. You can see the cities and the battle-fields where most of the history of the world has been made for the past 2,000 years.

Nor is any region of the world more delightful to the traveler. How rapidly the scene changes from the woods and parks of England to the carefully cultivated valleys of France; from the mountain pastures of Switzerland knee deep in flowers to the olive groves and vineyards of Spain and Italy; and from the canals and windmills of Holland to the deeply cleft fiords of the coast of Norway! And though even the loveliest of Europe's landscapes may be no more beautiful than the lakes and mountains of North America, you get a

sense of the mellowing effect of long human habitation such as we rarely feel in the New World.

How Europe is Warmed by the Ocean Winds

Europe has been the favored continent of civilization. It has no such formidable barriers of desert and mountain as Asia, no such vast distances, no such extremes of temperature. It lies entirely outside the tropical zone and almost entirely outside the frigid zone. Its average elevation above the sea is the lowest next to that of Australia. These two advantages, combined with the warm winds blowing from the Atlantic, give it the mildest and most genial climate of all land masses in the same latitude, as well as a wide distribution of rainfall.

Half the secret of the livable quality of this continent lies in its seacoast—20,000 miles of it if you take only the important indentations, and 50,000 or 60,000 or even more if you count every little bay and inlet—about one mile of coast for every 75 square miles of area. Besides being a long coast it is a western coast. What that means to the climate you will know if you have ever had occasion to compare a bleak Maine winter with the mild winter of the state of Washington, which lies even farther north. You will realize that the warm west winds from the ocean make the western edge of a large land body much warmer than the eastern, and so you will not be surprised to learn that balmy Venice is slightly farther north than the forbidding harbor of Vladivostok in Eastern Siberia.

Steam heat would probably never have been invented if America had the climate of the Channel Islands, which lie between France and England. There you are never hot, never cold, and the fire that you light in the grate of an evening is often just for the sake of cheerfulness. To a certain extent this equable climate is found in the larger British Isles as well, though they lie so far north that in summer it is still daylight at nine o'clock, with an afterglow to follow, and in winter the day is correspondingly brief. A delightful and still milder climate characterizes the Mediterranean islands—the Balearic group, Sardinia, Corsica, Sicily, Crete, Cyprus, and the Grecian archipelago in the Aegean.

A Peninsula of Peninsulas

In large measure the oceanic climate of the islands extends to the mainland as well. Europe has been called a peninsula of peninsulas, and nowhere else are such peninsular formations to be found—letting the sea and its equalizing winds far into the land.

If you should take ship as far to the southeast as possible, you would come first to the little peninsula of the Crimea reaching down into the Black Sea. Then sailing through the Bosporus at Constantinople, the Sea of Marmara, and the Dardanelles, you would travel far to the south to skirt the Balkan Peninsula, which is tipped by Greece. Continuing westward you would come to Italy, which is like a long pierhead of Europe almost joining the snowy Alps to the sandy Sahara. Then sailing the last half of the length of the blue Mediterranean, you would come to the Iberian Peninsula, which includes Spain and Portugal This is the second largest of all the peninsulas of Europe. It is so broad and high that, except for the low-lying rim, it has a continental rather than an oceanic climate. Continue through the Strait of Gibraltar, around Portugal, across the Bay of Biscay, through the English Channel, and into the North Sea, and presently you will come to the peninsula of Denmark jutting north from Germany. Just opposite is the Scandinavian Peninsula, the largest of all, shaped something like one of the warm woolen mittens you would need to wear there in winter.

The long deeply indented seacoast means commerce as well as a temperate climate. At first you will be surprised to find that most of the important seaports on the Atlantic lie well inland. Hamburg is 75 miles up the Elbe, and Bremen is about 50 miles up the Weser. Amsterdam lies at the end of a sea canal, Rotterdam some distance up the Rhine, and Antwerp at the head of the estuary of the Scheldt. Hull is on the Humber, and London on the Thames. Havre and Rouen are up the Seine, Nantes up the Loire, Bordeaux on the Garonne, Porto up the Douro, Lisbon up the Tagus, and Seville is no less than 70 miles inland on the Guadalquivir. But, you might ask, don't the great ocean liners and freighters have a hard pull to work their way so far inland? They would but for the fact that these rivers all have wide tidal mouths or *estuaries*, and that twice a day the strong tides of the Atlantic increase the depth of their waters.

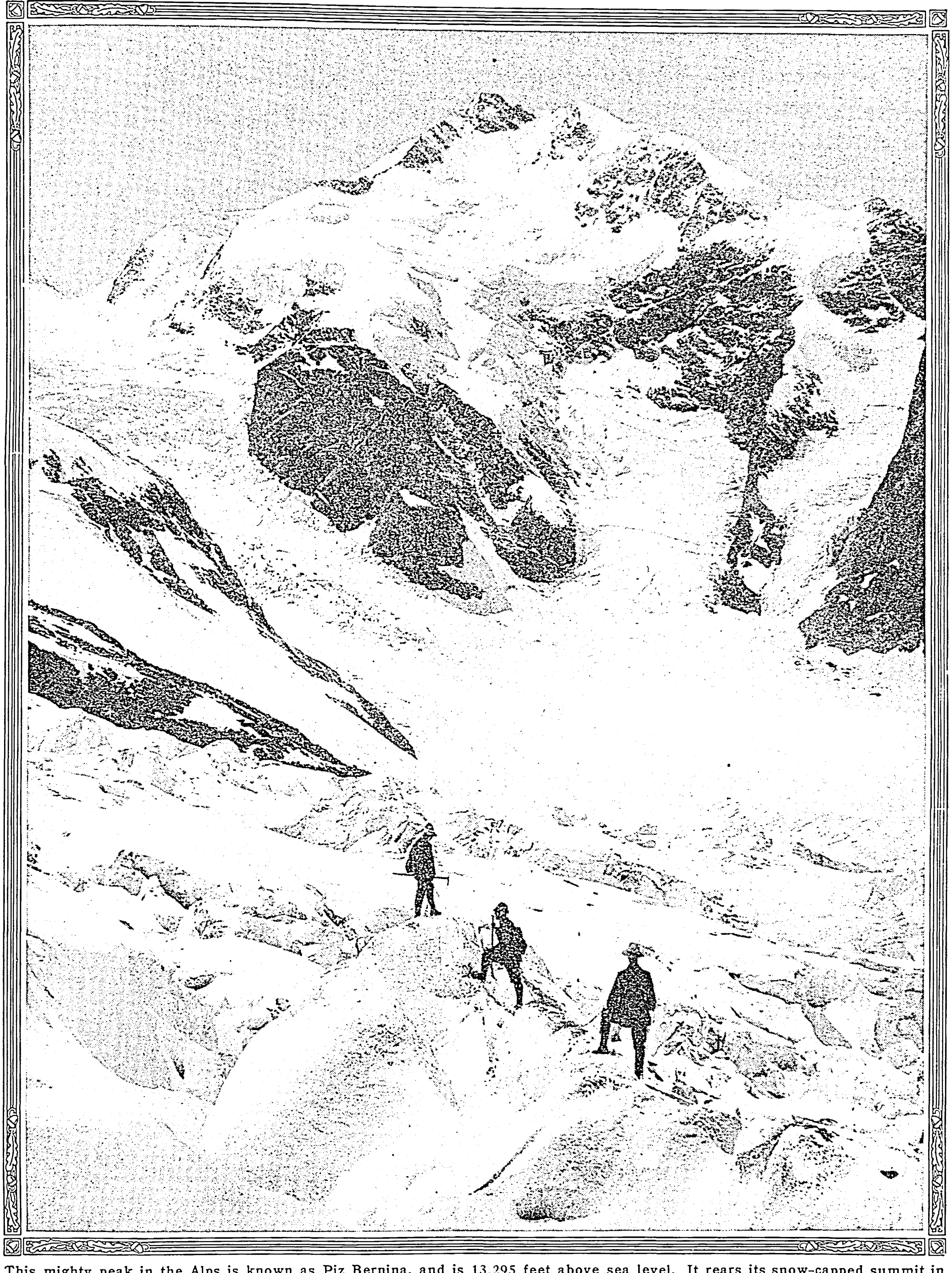
How the Mediterranean Lacks Rivers

The Mediterranean, unlike the Atlantic, commands no great navigable rivers. You will notice that the Ebro, the Rhone, and the Po are the only large rivers flowing into it or any of its arms. Of these the Rhone is too swift, and the others are at certain seasons too shallow for sea-going vessels. Nor would the Mediterranean river ports—if there were any—have the advantage of tides enjoyed by the Atlantic ports, for although there is a three-foot rise and fall at Venice, the Mediterranean tides are in general slight.

The ports of the Black Sea are of comparatively little importance, although into it flow four great navigable rivers—the Don, the Dnieper, the Dniester, and the Danube. The Danube is the second river of Europe and forms the great highway between Central Europe and the East. The Caspian receives the largest river of Europe, the Volga, which is navigable for 2,260 miles out of its 2,325, but is icebound for 100 to 150 days out of the year. This fact, together with the accident of its emptying into the landlocked Caspian, makes it chiefly important for local traffic along its course. The same is true of the northern rivers, the Pechora flowing into the Arctic, and the Dvina into the White Sea. These are icebound more than half the year, and only during the summer months can timbers, furs, and grains be brought to Archangel for export.

Europe's long seacoast creates industries of its own as well as fostering commerce. Fleets of fishing boats

A GEM IN EUROPE'S MOUNTAIN CROWN



This mighty peak in the Alps is known as Piz Bernina, and is 13,295 feet above sea level. It rears its snow-capped summit in southeastern Switzerland, near the Italian border, and looks northward across the famous Upper Engadine Valley. Those men in the picture must be hardy climbers, for the ascent is one of the most difficult in this whole region. Quite aside from their beauty, the Alps are of great importance to Europe. Their snows feed great rivers that water the fertile fields of Germany, eastern France, and Italy, and they supply cool breezes for the surrounding plains.

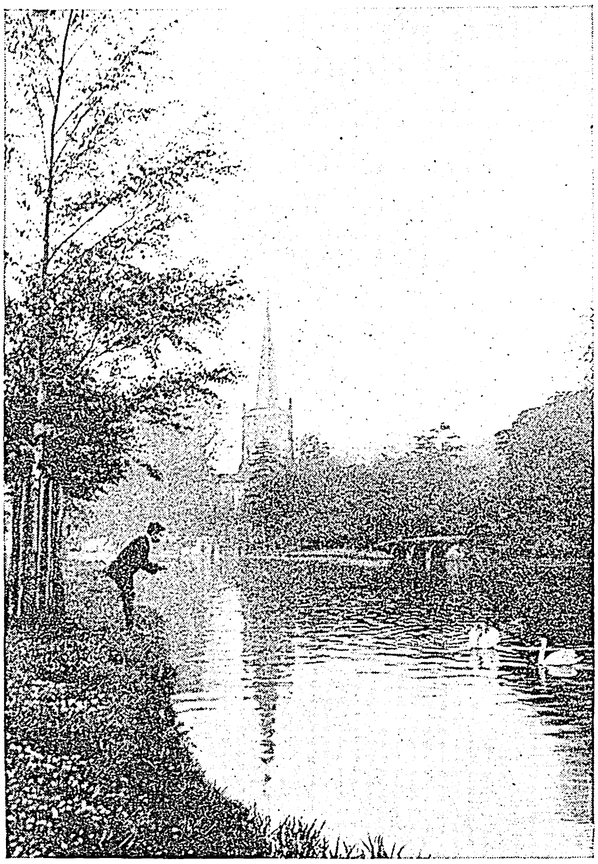
dot nearly its entire length, and push boldly out far into the open sea—to Arctic Iceland and the distant Banks of Newfoundland. In the Baltic and North seas the fisheries are practically inexhaustible, for the numerous rivers contribute mud and loam rich in fish food. Near the fishing grounds the curing of fish is an important industry. Olive oil and sheet tin for putting up sardines are among the largest imports of Norway, and smoked, salted, or pickled cod, salmon, and herring are also produced in large quantities. "Kippers" and Yarmouth "bloaters" (forms of herring) from Great Britain, and anchovies and sardines from the Mediterranean and the Atlantic coast of Spain and Portugal go all over the world.

How would the continent of Europe look if we could view it from high in the air and see its whole extent as a great panorama stretched out before our eyes? Imagine that we are soaring far above the Alps—the roof of Europe—in a captive balloon equipped with instruments powerful enough to bring any part of the continent we want beneath our gaze.

First look straight down. Under our feet lie the snow-capped peaks of the Alps, rising from valleys dotted with lakes and the rainy green of mountain meadows. This magnificent mountain range, from 10,000 to 15,000 feet high, is one of the many ranges of young rugged mountains of southern Europe.

As we turn our eyes to the south, we see the Alps falling steeply to the low fertile Po River basin, the plain of Lombardy. This is perhaps the most productive region of Europe; its meadows may be mowed six times in the year. On both sides of the Po valley the Alps thrust out long fingers to the southeast—young jagged ranges, but not so high as the central mountains. One of these, the Apennines, forms the backbone of Italy, reaching far into the Mediterranean and nearly joining Europe and Africa by way of the island of Sicily. On the eastern side of the Adriatic Sea we observe the Dinaric Alps, continued by the huge broken sprawling mass of highlands which make up the Balkan Peninsula, with the Balkan Mountains pushing eastward to the Black Sea, and the Pindus Range forming Greece.

ALONG THE BEAUTIFUL AVON



Without a doubt, young William Shakespeare fed the swans on the Avon, just as this man is doing here. The spire you see is that of the Church of the Holy Trinity at Stratford, which stands on the site of an ancient Saxon monastery.

Swing your gaze slowly eastward. Notice how the lines of the eastern wing of the Alps are prolonged northeastward across the Danube by the grand sweeping curve of the Transylvanian Alps and the Carpathians, which circle around the plain of Hungary. In this mountain-girdled basin great waving fields of wheat, corn, flax, and rye interchange with treeless steppes, where millions of horses, sheep, and cattle are grazing. The lower basin of the Danube, separated from the Hungarian plain by the gorge of the Iron Gate, where the Balkan and Carpathian ranges almost meet, is a far-stretching expanse of treeless plain. There the Rumanians raise their wheat and corn and pasture extensive herds.

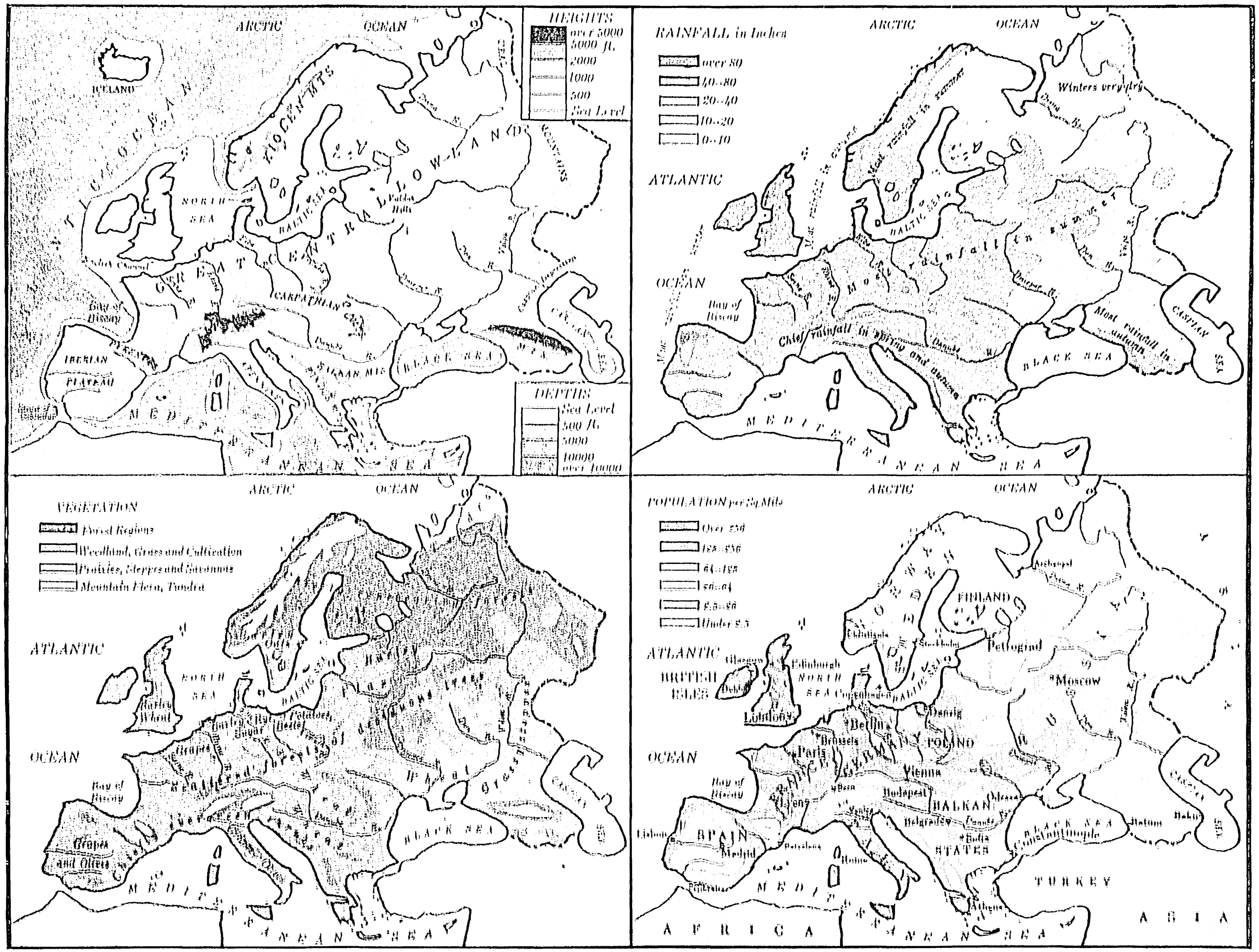
Look still farther, across the Black Sea, until your eye is caught by the enormous frowning mass of the Caucasus Mountains, rising like a wall across the neck of land that separates the Black and Caspian seas. This is Europe's southeastern frontier, a natural rampart towering 3,000 feet higher than the Alps.

Now let your gaze travel toward the north. In the far distance—2,000 miles from where your balloon soars—you dimly see the long low range of the Urals, which forms 1,200 miles of the boundary between Europe and Asia. These are old worn-down hills, the mere stumps of mountains that once rose steep and high, reaching from the Arctic Ocean almost to the Caspian.

Cast your eye over the vast Russian plain between the Carpathians and the Urals. What a prodigious expanse of monotony! Nearly the whole of it is covered with enormous grasslands and fields of wheat and other grains, potatoes, and sugar-beets, alternating with woods and marshes.

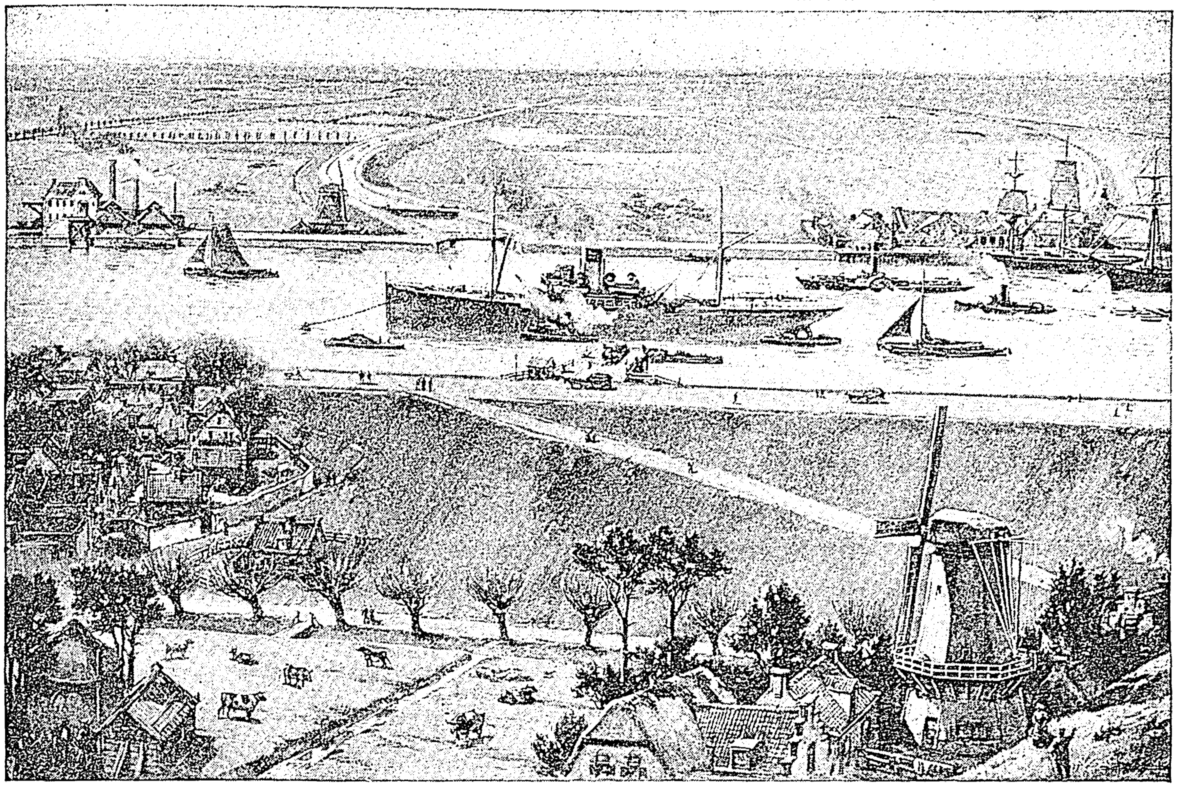
In the far south, near the Black Sea and the Caspian, the plain becomes a treeless steppe, covered with tall grasses which conceal the pasturing herds of the nomadic inhabitants. Around the margin of the

FACTS YOU SHOULD KNOW ABOUT EUROPE



The well-scattered mountain systems of Europe give it a fairly even distribution of rainfall, which in turn largely accounts for the plentiful vegetation, the concentration of peoples, and the high civilization.

LITTLE HOLLAND AND THE MIGHTY SEA



After a summer vacation in Holland, among the principal things you would carry away in your memory would be those which the artist has brought together in this picture: The coast line with its dikes designed to keep back the sea and to furnish walls for the canals, which are so vital a part of Holland's transportation system; the roadways with their bordering trees like those in the upper left distance; marshy lands partly flooded (shown to the right) with a large canal or river in the center crowded with big and little boats. Just this side of the marshy land is a "polder," a morass which has been drained and is now cultivated. Notice the roadways on the top of the dikes, the villages below water level, the windmills, and the cattle in the rich green pasture lands.

Caspian, in the basin which that sea once occupied, the soil is so filled with salt left by the retiring waters that few plants will grow.

In the far north, next the icy Arctic Ocean, the plain takes the form of the moss-covered swamps called "tundras," which never thaw for more than a yard's depth. Here grow only mosses, lichens, dwarfed trees —many only a few inches high—and a few hardy plants which greet the midnight sun of the brief summer with the gaudiest of flowers.

From our gently swinging balloon we let our gaze travel on, following the line of the Arctic Ocean to the west. Plains, nothing but plains, until we spy the forest-covered hills of Finland between the Arctic Ocean and the Baltic Sea, with its girdle of cliffs rising steeply from the sea. Its granite floor of old worn-down hills, something like New England, is worn into thousands of angular lake basins, which cover its surface in a network.

Looking still farther west, we observe that the upland of Finland rises into the broad highland mass of the Scandinavian peninsula, which reaches south between the Gulf of Bothnia and the Atlantic. The mountains of Sweden and Norway have been worn down by the ages into a series of broad plateaus dotted with clear blue glacial lakes. Their base too has sunk deeper into the ocean, allowing the sea to enter the valleys and making the steep-walled fiords which everywhere cut the Atlantic coast of Norway.

Follow the line of the Scandinavian peninsula southwestward to the British Isles, across the North Sea. If we could look down through the waters to the ocean bottom, we should see that the North Sea is far shallower than the rest of the Atlantic. In fact the North Sea is a drowned plain which once rose above the surface of the ocean and joined the British Isles with continental Europe. This whole region has now sunk so far beneath the waves that only the high plateaus and tops of the mountains still remain uncovered, forming the British Isles.

Swing your eyes back to the great plain—the "bread-basket" of Europe. Notice how it continues westward along the Baltic Sea forming the fertile lowlands of the Baltic states of Esthonia, Latvia, Lithuania, and of Poland. Farther on it forms the northern half of Germany, with the little Danish peninsula jutting north as if to meet the Scandinavian. As it swings to the south along the North Sea, it narrows down, forming Holland and the lowlands of Belgium—much of it so low that it is actually

SUMMER SUNSHINE ON THE BAY OF BISCAY

Its fine sandy beach and pleasant tree-lined promenades like that above, with cooling breezes from the Bay of Biscay, on which it stands, make San Sebastian a favorite summer resort of wealthy Spaniards. The visitors have built many fine villas. The railroad line from Madrid to France passes through this Basque city, which lies in northernmost Spain, only a few miles from the French frontier. A strong fort dominates San Sebastian.

below sea-level and is only prevented from being drowned like the rest of the old North Sea plain by a great system of dykes. In northwestern France the plain enlarges, forming the fertile Paris basin. On it goes, past the plateau of Brittany—once a part of the chain of mountains that ran all the way in a great semicircle through the British Isles to Scandinavia—again expanding to form the great wine and wheat district of the Garonne River valley.

Here our gaze is stopped by the formidable barrier of the Pyrenees, the young and rugged range which completely shuts off the Spanish peninsula from the rest of Europe, except around its flanks. On the other side of the Pyrenees we see the dry barren plateaus of Spain, traversed by chains of mountains and bordered by narrow strips of lowlands along the coast.

We have now swung around the whole of the continent of Europe and noted its most important natural features, except for the central highlands that slope north and west from the Alps to merge into the long coastal plain. Now look westward, across the Rhone. Notice the worn-down ranges of the Cevennes, continued to the north by the forest-clad Jura Mountains and the Vosges. Beyond and almost below us, bordering the Rhine Valley, rise the Black Forest and the other ranges of hills, mountains, and highlands that make up central, southern, and eastern Germany. These central highlands are the treasure house of Europe. They contain the great iron and coal mines on which the industrial prosperity of Europe depends; and they are rich in many other kinds of minerals, as well as water power and timber.

No United States of Europe

Now how is it that we do not have a United States of Europe as we have a United States of America? Europe is so small, so compact, so united by its excellent seacoast without and by its many navigable rivers within, that we might expect to find it the seat of a single government. Why must you know 50 or 60 languages to converse with the natives of all the various parts of Europe, while one will suffice for almost the whole of the much larger continent of North America? Why should some of the Swiss cantons speak German, others French, and yet others Italian? Why should there be two different nations speaking different (though somewhat similar) languages in the Scandinavian Peninsula, and again in the Iberian Peninsula? Why in the small compass of the British Isles should there be four distinct national areas, England, Scotland, Wales, and Ireland? Why should Holland and Denmark—which would both go into Ireland and leave some to spare—have each its own language? Why should not the tiny states of the Balkan Peninsula, with their common

interests, have clubbed together to form a single government for the region?

That part of the secret of Europe does not lie in the coast line, but in the internal formation—the multiplicity of short mountain ranges and little valleys. Something is due of course to the history of the settling of Europe, and something to accidents of conquest; but the main story is told in the minute diversity of surface that gives every little section its own personality.

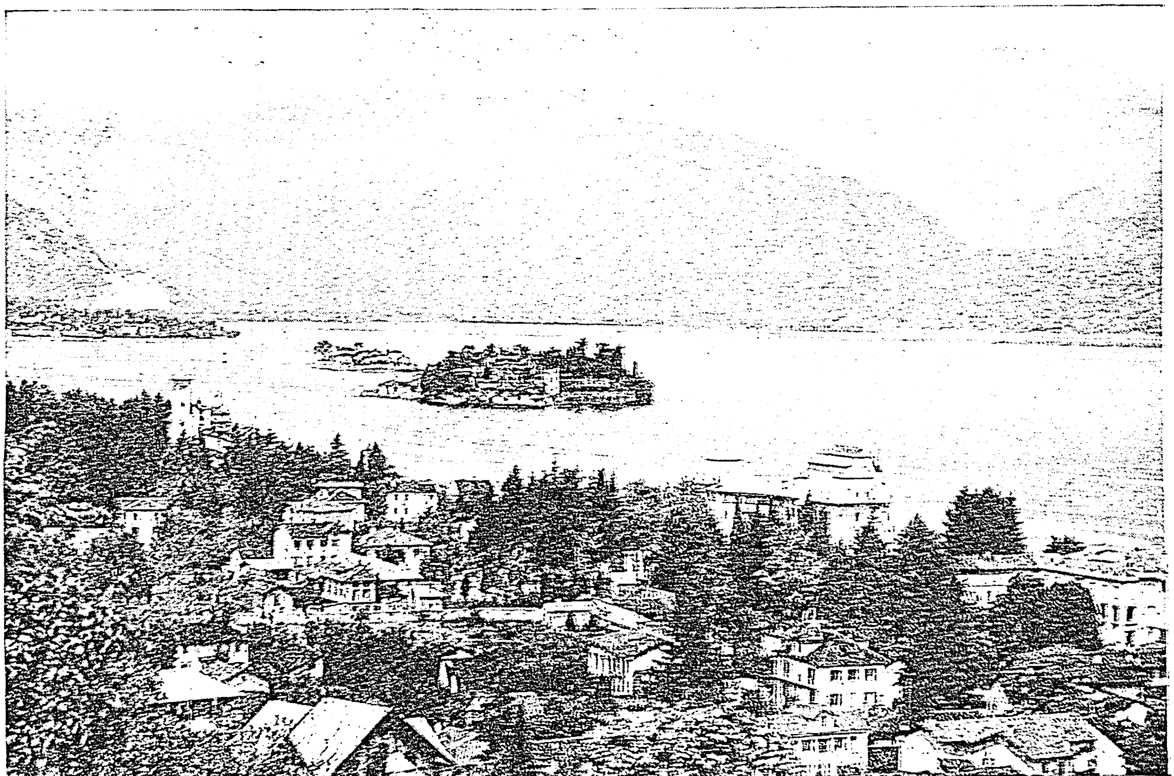
For an example of the isolating influence of even moderately high mountains you have only to consider the mountain peoples of Kentucky and Tennessee. You will then understand how language and tradition have been preserved in the hills of Scotland and Wales, and how the mountain backbone of Scandinavia marks off the Atlantic fishing country of Norway and the Baltic country of Sweden, with its rich mines and the wider flatter surface that helps to foster farming; how mountains isolate the various parts of Spain from one another; and how every little racial group in the Balkans has preserved its own national character through the centuries. So, too, with the mountain barriers of Switzerland, which, while separating the cantons, have long been ramparts of freedom for their bold and independent peoples.

The existence in our own day of such small countries as Belgium, Holland, and Denmark is frequently explained by their convenience to the larger countries as buffer states. This does not explain their origin, however, nor why the experiment of uniting Belgium and Holland in 1815 was a complete failure. Holland is simply the delta land of rivers, and its low-lying soil growing coarse salty grasses is good only for cattle raising, the dairying industry, and a few root crops. The pyramids of cheeses—round ones painted cherry red, pineapple ones varnished yellow—combine with the canals, dykes, and windmills to give Holland an individuality quite different from that of its mining and manufacturing neighbor Belgium.

France, the Land of River Valleys

France is the land of river valleys; the Seine, the Loire, and the Garonne flowing into the Atlantic, and the swift, "arrowy" Rhone, walled in by the Cevennes Mountains, the Alps, and the Jura, into the Mediterranean. France has about 3,500 miles of navigable river joined by 3,200 miles of canal. And in like manner each of the political divisions of Europe—even each little section speaking a different language—has a distinct personality based upon its geographical features, and the consequent isolation of its customs and interests from those of its neighbors.

AMONG THE FAMOUS LAKES OF NORTHERN ITALY



Among the Italian Alps, near the Swiss border, lies a group of lakes, in the midst of scenery unsurpassed anywhere in Europe for grandeur and colorful beauty. This is a view from the little town of Stresa, looking across the western arm of Lake Maggiore. The Borromean Islands, which you see, were once barren rocks. But Count Vitaliano, a wealthy 17th century nobleman, carried soil to them from the mainland, and established gardens, which now bloom with oranges, magnolias, and oleanders. His old unfinished chateau on the nearest island (called Isola Bella, "the Beautiful Island") contains today many beautiful paintings and tapestries.

Although Europe, with the exception of Australia, is the smallest of the continents, it is the most densely populated. Its area would go about three times into Africa and more than four times into the Americas or Asia. Yet it has an estimated population of 530,000,000—nearly half as much as Asia's, and almost twice that of the Americas. Europe long ago reached the stage where it could not raise enough food to feed its teeming and enterprising peoples. This, combined with the multiplicity of frontiers, has been a recurrent cause of wars among the European nations. It is also a chief reason why England, France, Spain, and Portugal spread over into the Americas, and why the race for the control of Africa and Asia has produced such bitter and fateful national antagonisms. There are still so many people in Europe that few of the countries could feed or clothe themselves without imports. Especially home agriculture cannot provide for England and Belgium. These are the two most densely populated countries, because they have an abundance of coal and iron and therefore have become great workshops for the rest of the world.

To feed its people and its looms and furnaces, Europe imports chiefly raw materials—oils, rubber, meats, hides, cotton, wool, timber, wheat, copper, zinc, and tin ores. It exports finished goods—silk and wool fabrics, paper, machinery, glass, leather, and chemicals.

Europe furnishes more than half of the world's iron ore, and almost half of its zinc and aluminum ore; half its coal, a little over a fourth of its lead ore, and four-fifths of its mercury; over a third of the world's salt, and most of its potash.

A quarter of the world's wool is produced in Europe; half its wheat and oats; two-thirds of its barley (excluding China's production); four-fifths of its potatoes; and most of its olive oil, hemp, rye, flax.

Some Interesting Facts about Europe

On a map of the world, Europe is only a peninsula of Asia. Geographers have given the name Eurasia to the continents of Europe and Asia considered together.

Europe is the only continent which has no desert areas. Two-thirds of it consists of lowlands. Vesuvius and Etna are among the few active volcanoes of Europe.

Comparatively few wild animals still remain. Reindeer and polar bears roam parts of the far north, and a species of wild ox is occasionally found in the forests of Poland and Lithuania. Some of the wilder forest regions are infested by wild boars, bears, and wolves. The lynx is common in Sweden and Norway. The chamois, in small numbers, still wanders over the Alps, the Pyrenees, and the Carpathians. Deer and other game preserves are numerous.

Europe falls into three main climate divisions: (1) the Mediterranean region, where the summers are dry and hot and the winters mild and rainy; (2) the east, where most of the rainfall comes in the summer and where the differences between summer and winter are great; and (3) the west, where the rainfall is distributed throughout the year and the changes in temperature are slight.

Europe is the chief manufacturing center of the world. No other continent has so many people engaged in manufacture.

Both the world's largest city, London, and the world's smallest independent state, Vatican City, are in Europe. Vatican City, which is only about 109 acres in area, is under the temporal rule of the pope (*see* Pius, Popes). The second smallest state in Europe is the principality of Monaco, which occupies about 370 acres (*see* Monte Carlo). Three other small countries are the republic of San Marino, 38 square miles, in northeastern Italy; the principality of Liechtenstein, 65 square miles, between Switzerland and Germany; and the republic of Andorra, 191 square miles, in a valley of the eastern Pyrenees between France and Spain.

A large part of Europe was once covered with forests. Ages of reckless destruction exhausted the timber over many thousands of square miles, and this so seriously affected climate and irrigation that the leading governments now replant and care for forests systematically.

The Thrilling Panorama of Europe's History

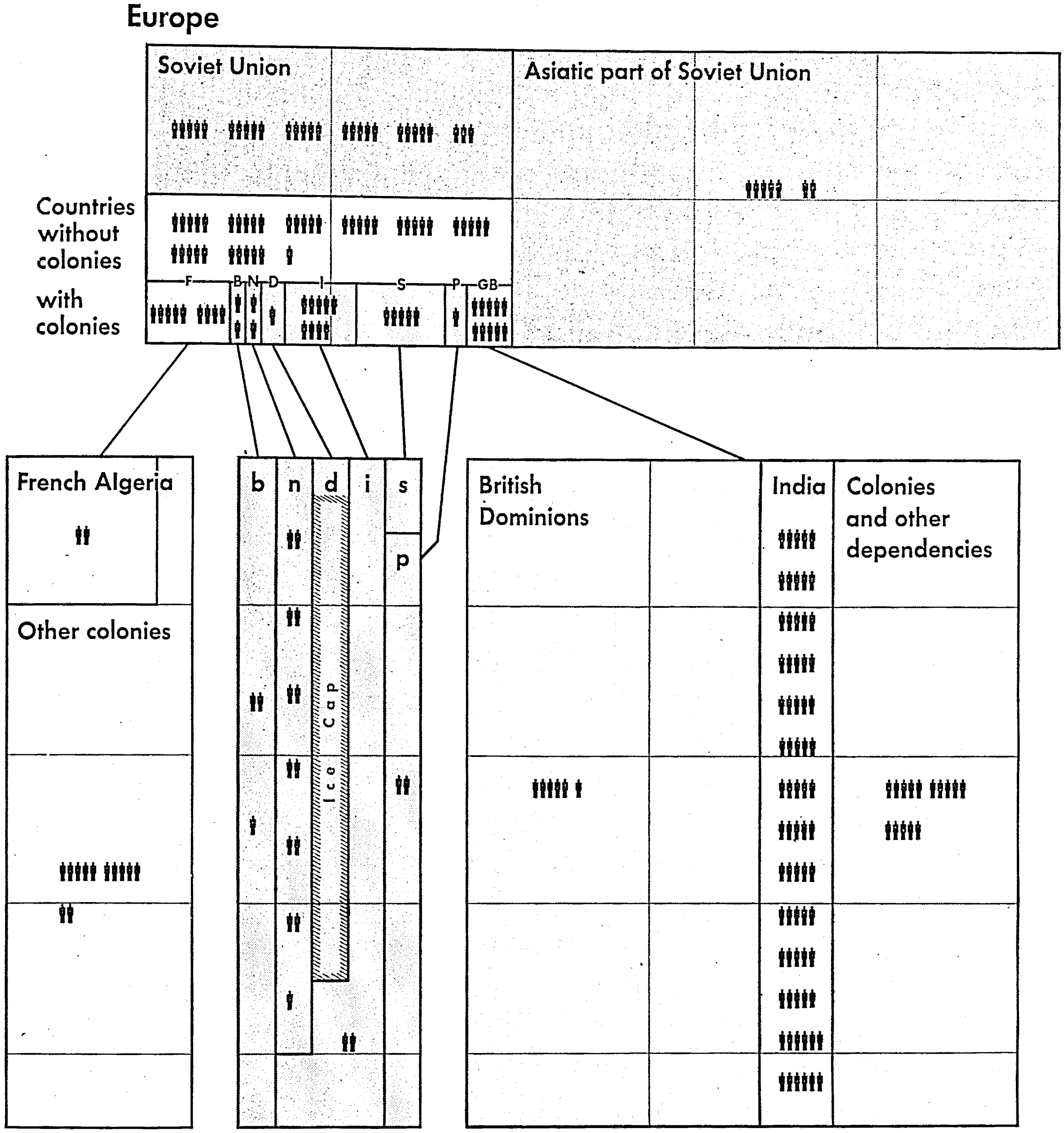
TWENTY-FIVE thousand years ago, at the close of the last "Ice Age" or glacial epoch, primitive man had already marked Europe for his own. From the caves of France, Spain, Germany, and elsewhere; over wooden villages set on piles driven into lake- or river-bottoms; from southern Sweden and Switzerland to the heel of Italy and the Black Sea—the smoke of his camp-fires floated over the forests. With inconceivable slowness and pain he rose from savagery to barbarism. More advanced civilization began, about 2,500 years B.C., to come from Egypt and Asia, by way of the islands of the Aegean Sea. In course of time this flowered into the splendors of Greek and Roman culture. With these two peoples there begins the recorded history of Europe, as opposed to our dim glimpses into its prehistoric past. (*See* Aegean Civilization; Cave Dwellers; Civilization; Ice Age; Stone Age.)

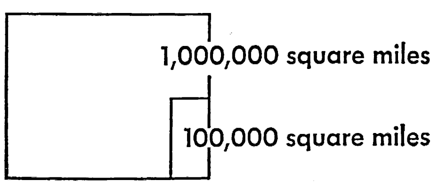
The Germans Invade the Roman Empire

On the death of Theodosius the Great (395 A.D.) the Roman Empire was divided finally into two parts—the Western Empire with Rome as its capital, and the Eastern Empire (also called Greek or Byzantine Empire), the capital of which was at Constantinople (*see* Byzantine Empire). Beyond the boundaries of the Roman world were numerous barbaric peoples, divided into three main groups: (1) remnants of the great Celtic stock in outlying parts of the British Isles; (2) Germans or Teutonic folk lying along the Rhine and Danube rivers and in the Scandinavian Peninsula; and (3) the great mass of the Slavs, ancestors of our modern Poles, Russians, Czechs, Serbians, and others, whose tribes even then lay eastward of the Teutons.

The German barbarians were divided chiefly into Goths, Burgundians, Vandals, Alemannians, Bavarians, Langobards (Lombards), Franks, Angles, Saxons, Frisians, etc. The Gothic tribes (Visigoths and Ostrogoths) for nearly 200 years had been established along the shores of the lower Danube and the Black Sea. This region was invaded by the Huns from Central Asia and its inhabitants pushed westward, causing

European Homelands and Their Colonial Empires 1940



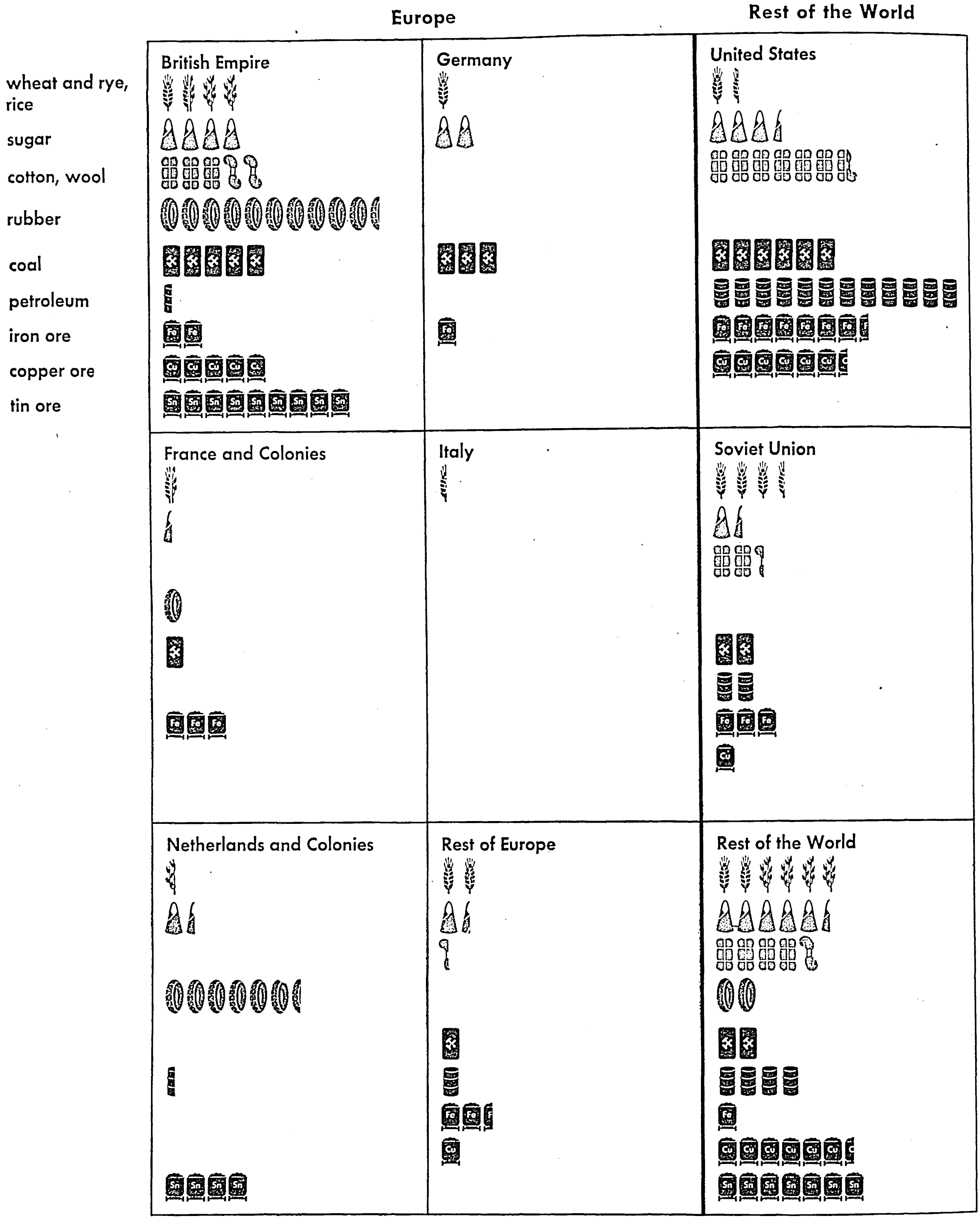


Each man symbol represents 5 million population

Homelands	Colonies
GB: Great Britain	
F: France	
S: Spain	s
I: Italy	i
D: Denmark and Iceland	d
P: Portugal	p
N: Netherlands	n
B: Belgium	b

Notice that (without counting Soviet Russia) the European countries which have no colonies occupy a larger area and contain a greater population than do the colony-owning countries. Observe also how sparsely populated are the colonial areas with the exception of India.

Raw Materials - Europe and the Rest of the World



Each complete symbol represents 5 % of world production.

Prepared for Compton's Pictured Encyclopedia

the great Gothic invasion (375 A.D.). Gaul was overrun chiefly by Visigoths, Burgundians, and Franks; Spain by Vandals, Suevi, and Visigoths; Africa by Vandals, crossing from Spain. Italy suffered a number of invasions, especially those of the Visigoths, Ostrogoths, and Lombards; Britain, after being abandoned by its Roman garrison (410 A.D.), became a prey to Angles and Saxons sailing in their piratical vessels from their homes about the mouth of the river Elbe. But the influence of Rome—its language, law, and government—left a stamp which has never yet wholly been effaced.

It was the task of Charlemagne (768–814), building on the foundations laid by the Frankish kings who preceded him, to consolidate the Germanic conquests into an empire which stretched from the Ebro River in Spain to beyond the Elbe, and from the North Sea to a little south of Rome in Italy. The decline of classical civilization was checked; something of the Roman tradition of unity, order, and centralization was preserved in the face of advancing feudalism; and Christianity was spread through most of Western Europe (*see* Charlemagne). But Mohammedanism, established in Spain since 711, lingered in that land until the Moors were finally conquered in 1492.

Rise of Modern States

The division of the Frankish empire in the Partition of Verdun (843) became the starting point of the kingdoms and nations of France and Germany. Under Otto I, king of Germany, 936 to 973, the empire in the West was a second time revived, under the title "Holy Roman Empire." But it now included only Germany and Italy and its power grew ever less until its extinction in 1806. The Eastern Empire, in spite of many vicissitudes, fulfilled its function as a bulwark against Asiatic conquest and Mohammedanism until it was overwhelmed by the Ottoman Turks (fall of Constantinople, 1453). Where Hungary now is dwelt the Asiatic Avars, whose place was taken in the 10th century by their kindred the modern Magyars. Nothing but the little kingdom of Asturias was left of the Gothic power in Spain; but from this seed grew the Christian realms of Castile, Leon, and Aragon, which were consolidated in the 15th century into the kingdom of "their Catholic Majesties," the sovereigns of modern Spain.

The viking Northmen, after raiding from their Scandinavian homes the coasts of all western Europe in the 9th century, settled in western France in 911; then as "Normans" they founded the kingdom of Naples and Sicily in Italy, and gave a new dynasty to England (1066). Their descendant on the female side, Henry II of Anjou, was king of England, lord of Ireland, and feudal holder of Normandy, Anjou, Brittany, and Aquitaine in France. Only gradually were the Capetian kings of France able to reconstitute the unity of their kingdom and set it on that path of internal growth which made it under Louis XI, 1461 to 1483, the first strong monarchical state of modern times. Meanwhile the "States of the Church" were established in Italy as the temporal dominion of the pope; Poland and Russia became settled Christian states; the heathen Prussians were christianized and Germanized by the Order of Teutonic Knights; feudalism, Christianity, monasticism, and medieval art and learning spread everywhere, and the Crusades, the growth of town life, and reviving commerce prepared the way for that rebirth of the human spirit which we call the Renaissance (*see* Crusades; Renaissance).

Wars of Religion and Conquest

The expedition of Charles VIII of France, in 1494, to assert his claim to inherit the kingdom of Naples and Sicily started a series of wars over Italy which embroiled France and Spain for half a century and enabled the Reformation started by Luther to get such a spread that it could not be stamped out. The close of the conflict left the Emperor Charles V not only ruler of united Spain and Germany, but also of Sardinia, Sicily and Naples, Milan, the Netherlands, the county of Burgundy (Franche Comté), and a great part of the New World. His brother Ferdinand I, archduke of Austria and emperor and head of the German branch of the Hapsburgs after Charles, obtained by marriage Silesia, Bohemia, and that part of Hungary which had not fallen into the hands of the victorious Turks. The power of the Spanish Hapsburgs, under Charles' son, Philip II, and his successors, steadily declined.

The close of the Thirty Years' War (1618–1648)—the last of the wars of religion—left the Holy Roman Empire greatly weakened and practically confined to Germany and Austria. France became again the first power of Europe, having obtained much of the Burgundian lands (including Franche Comté, conquered by Louis XIV, 1643–1715). Savoy, straddling the French Alps, was becoming an Italian power. Spain still held the Spanish Netherlands (Belgium) and a great part of Italy. The Protestant Netherlands (Holland) and Switzerland had freed themselves by successful revolt from the Empire. Sweden, independent of Denmark since 1523, was one of the great powers, having conquered territories alike from Germany, Poland, and Russia. Denmark still ruled Norway. The duchy of Prussia, united to the mark of Brandenburg in 1618, was soon (1701) to give its name to a new German kingdom erected by the military power of the Hohenzollerns.

Shifting Fortunes of the Nations

In the 16th century Poland (in union with Lithuania since 1569) was one of the most powerful states of Europe, stretching from the Baltic almost to the Black Sea; but the 18th century saw its steady decline. Russia, under Peter the Great (1689–1725) and Catherine II (1766–96), became a formidable and disquieting power. Turkey, though decreased since its high-water mark of conquest in the 17th century, still retained the greater part of the former Eastern Empire. Venice held an extensive sway in the Adriatic and the Eastern Mediterranean; and Genoa held Corsica until it passed to France in 1768.

Soon after the outbreak of the French Revolution (1789) Poland ceased to exist, through partition by its greedy neighbors. Prussia had risen to the rank of a great power following the wars of Frederick the Great. Sweden had lost the leadership of Northern Europe. The Spanish Netherlands had passed to Austria in 1713, at the close of the War of the Spanish Succession; and branches of the French house of Bourbon ruled the parts of Italy that had been Spanish, as well as Spain itself. England had become the head of a British Empire, and had originated the inventions which led to the Industrial Revolution, a change quite as important in its way as the French Revolution. As "the Mother of Parliaments" it was the model to the world of constitutional government and political liberty during the first half of the 19th century.

The French Revolution and After

The wars of the French Revolution (*see* French Revolution) began a series of changes that ended in the extension of Napoleon's direct empire over Germany west of the Rhine, the Netherlands, northwestern Germany, and a great part of Italy and Dalmatia. In addition his brother Joseph was king of Spain, his brother-in-law Murat sat on the throne of Naples, and the grand duchy of Warsaw and the Confederation of the Rhine were ruled by his creatures. After the fall of Napoleon at Waterloo, the Congress of Vienna forced France to retire within its old limits, and in large part restored the old government. But Russia was allowed to annex Finland from Sweden and increase its Polish territories by absorbing the grand duchy of Warsaw. Prussia was enlarged at the expense of Saxony and by annexations on the west bank of the Rhine. Austria was given northern Italy in exchange for Belgium, which was united in unstable union with Holland until 1830. Norway was torn from Denmark and given to Sweden, with which it remained united until 1905. The states of Germany (now reduced from several hundred to 38, including Austria and Prussia) were organized into a loose union called the German Confederation, to replace the Holy Roman Empire, which had now disappeared.

The Holy Alliance and the Grand Alliance

To sanctify these new arrangements the four victorious Great Powers—Great Britain, Prussia, Russia, and Austria—formed the Holy Alliance, a brotherhood of sovereigns pledged to govern by Christian principles. They also formed a four-power alliance, called the Grand Alliance, to which France was admitted in 1818. It was pledged to the more practical purpose of preserving legitimate (meaning hereditary) government and the terms of the Vienna settlement. This group of states dominated the Concert of Europe, the system whereby no important change might take place without the consent of these Great Powers. An accompanying principle, the *balance of power*, required that no one of the Great Powers should become strong enough to dominate the others. It was this principle which France had violated under Napoleon and which the Concert of Europe reëstablished.

Industrial Revolution and Growing Nationalism

But no pressure of the Great Powers could permanently block change. The intense nationalism and hatred of absolute monarchs developed in France by the Revolution had spread throughout Europe. The development of the steam engine made factories and railroads possible, and created a new class of industrial rich, who resented the control of the landed nobility and demanded that governments protect the development of industry and keep out foreign goods. The new class of factory workers followed its employers and opposed the old nobility.

Yet for 30 years, under the leadership of Metternich of Austria, the Great Powers preserved much of the Vienna settlement. In 1830 Belgium broke away from the Netherlands in the name of nationalism, and France replaced its absolutist Bourbon king by a monarchy more favorable to business, under Louis Philippe. But the Concert broke a democratic revolt in Spain, and Russia put down a nationalist revolt in Poland. In 1848, however, a worse storm broke and Metternich himself fled. In that year and the following one, a temporary republic was established in France, the King of Prussia and the Austrian Emperor were forced to grant constitutions, and Hungary and northern Italy revolted against Austria. Again reaction triumphed; France submitted to the dictatorship of Napoleon III. The Frankfort Assembly, composed largely of intellectuals, failed to prepare an acceptable German constitution and was disbanded. Austria suppressed the Hungarian rebellion with Russia's help and reconquered its Italian provinces.

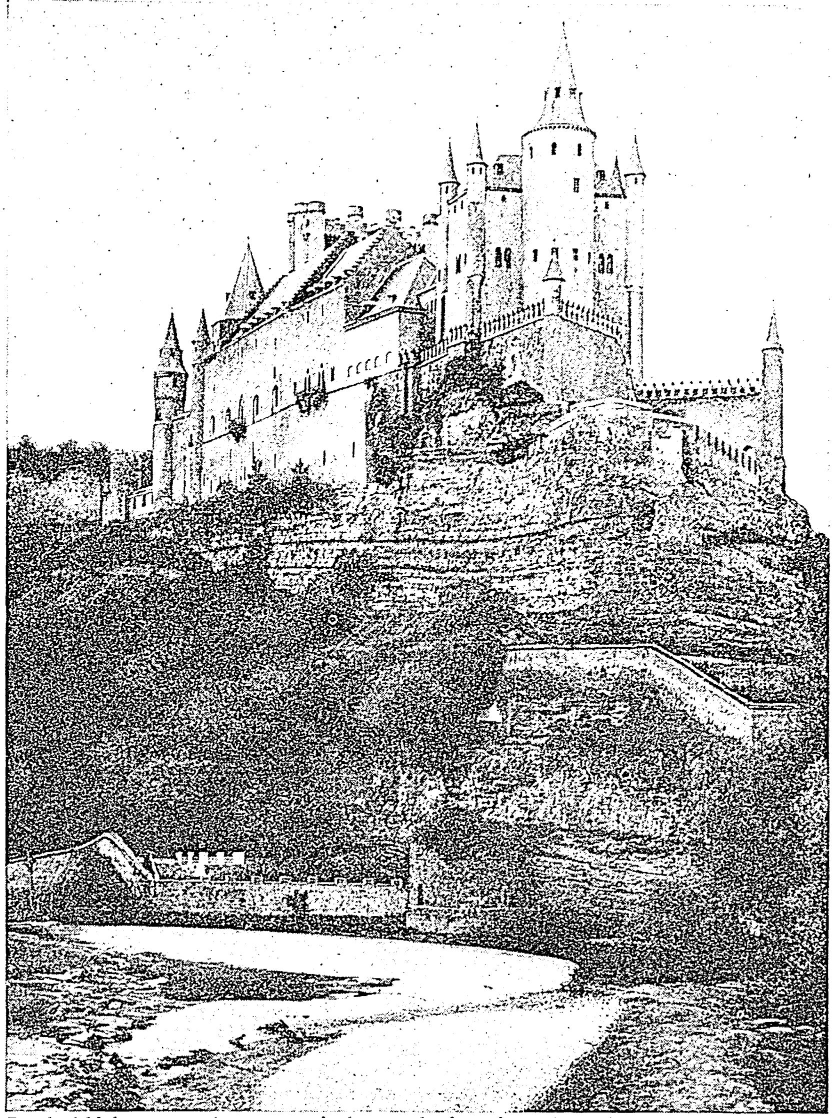
But now for half a century nationalism developed—the political union of people with common racial, territorial, or emotional attachments—and swept away much of the Vienna system. France under Napoleon III helped the kingdom of Sardinia free the rest of Italy and unite it into one kingdom. Bismarck, prime minister of Prussia, undertook three wars which drove Austria out of the German Confederation, and united the rest of the Germans in the German Empire under the hereditary rule of the king of Prussia. The Turkish Empire in Europe gradually fell apart, and the Concert of Europe supervised the establishment of the small nations as they broke away—the Christian Balkan states of Greece, Serbia, Bulgaria, and Rumania. When Russia attempted to intervene independently in Turkey in 1853, the ensuing Crimean War forced Russia to submit to a settlement by the Concert.

The principle of nationalism was sometimes violated. Bismarck, after the Franco-Prussian War, annexed Alsace-Lorraine, with a largely French population, because German industry needed the iron and potash of that region. In 1867, after its defeat by Prussia, Austria formed the dual monarchy of Austria-Hungary, making the people of a number of nationalities subject to these two. Economically, however, this empire was a sound arrangement, because the farm products of one part could be exchanged for the

industrial products of another.

Meantime, while the poorer classes were becoming more dependent economically on industrial owners, they were gaining political freedom. In 1815, Great Britain was still largely controlled by a few landowning families. Beginning with 1837, the right to vote was given to progressively larger bodies of citizens, until by the time of the World War it was possessed by practically all adult males, and in 1911 the House of Lords lost its power to veto laws voted by the more democratic House of Commons. In 1870 Napoleon III was driven from the French throne and a republic was set up. In Spain a revolt in 1868 against the despotic Queen Isabella succeeded, but the new democratic government failed to find another sovereign. Italy in the process of unification drove out the absolute monarchs formerly in control, substituting the democratic monarchs of the House of Savoy. The Scandinavian states, the Netherlands, and Belgium lived under monarchs with strictly limited powers.

THAT "CASTLE IN SPAIN" OF YOUR DREAMS



Perched high on a great crag, seemingly a work of magic produced from the rock itself, the Alcazar of Segovia has brooded over the surrounding countryside for hundreds of years. Built, probably on Roman ruins, by Alfonso of Castile, when he was fighting the Moors in the 11th century, it was partly destroyed by fire in 1862, but was rebuilt twenty years later. The city of Segovia lies behind the castle, 60 miles north of Madrid.

Colonies and Alliances

In the latter part of the century the factories of the Great Powers were able to produce more than they could sell at home, and they also needed raw materials produced elsewhere. So they pushed their governments to seek colonies abroad, rather than fight one another for European markets. Great Britain, France, and Germany conquered great colonial empires in Asia and Africa, and Russia spread all the way across northern Asia. These empires came into contact, and friction developed. The powers then developed markets in the smaller European states, with the same result.

From this situation developed an armament race and systems of alliances which eventually broke up the Concert. Russia initiated two conferences at the Hague in 1899 and 1907 to check the armament race, but these resulted only in setting up a court of arbitration which the states were not obliged to use (*see* Arbitration) and in establishing rules for war which were broken in 1914. Armaments increased faster than ever, and each state grew closer to its allies. Germany and Austria-Hungary, fearing Russia, formed an alliance. France and Russia, fearing Germany, did likewise. Italy, piqued at France, who blocked its African expansion, joined Germany and Austria in the Triple Alliance, but wavered when France made concessions. Great Britain, though preferring to avoid continental alliances, feared Germany's growing navy and so supported France and entered into the Triple Entente with France and Russia.

The Balkan Wars and the World War

In 1912, against the wishes of the Concert, the Balkan states went to war to capture the Turkish territory inhabited by their nationals (*see* Balkan Penin-

sula). Serbia, exulting in the ensuing victory, started propaganda for annexing Bosnia and Herzegovina, part of Austria-Hungary inhabited by Serbs. The assassination of Francis Ferdinand, Austrian crown prince, in the Bosnian capital of Sarajevo, June 28, 1914, was a result of this propaganda. Austria's determination to crush Serbia brought Russia, as protector of the Slav states, to Serbia's side. The two systems of alliances then engulfed all Europe in the World War (*see* World War of 1914–1918).

Changes in Europe After the War

The changes in Europe resulting from the war were far-reaching. Old boundaries and political institutions disappeared, social classes rose or fell, and perplexing new economic problems appeared. The Czar of Russia was killed and replaced by a proletarian soviet system, under the dictator Lenin. The emperors of Germany and Austria were dethroned, and republics were established. The Ottoman Sultan was replaced by Mustapha Kemal, an army-supported dictator. Farmer revolts in eastern Europe broke up the great estates into small farms, and impoverished the old agricultural nobility. Labor received new rights. England, Germany, Russia, and Poland gave women the vote. Subject races broke Austria-Hungary and Turkey apart and tore pieces from western Russia. The inhabitants joined their racial brothers across the frontiers or set up new states.

Every government had spent recklessly during the war and was hopelessly in debt. War taxes, property destruction estimated at 90 billion dollars, and the death of the family wage earners had impoverished the people. Insolvent governments issued paper money, which in Germany and elsewhere lost all value and impoverished those living on savings.

The Peace Treaties

The Paris Peace Conference attempted the task of reconstruction, through a series of separate treaties with the defeated states. The hope that the Concert of Europe might be replaced by a democratic League of Nations, where all states would be represented, was embodied in the Covenant of the League which was included in all the treaties. (*See* League of Nations.)

Otherwise the treaties embodied all the war's fears and hatreds. The Treaty of Versailles with Germany returned Alsace-Lorraine to France, took away Germany's colonies, disarmed Germany on land and sea and in the air, and forced it to make undetermined reparation payments for war damages.

The other defeated states were also disarmed. The treaties of Saint-Germain with Austria and Trianon with Hungary were supposedly based on the principle of nationalism. Czechoslovakia and Poland were created, and Yugoslavia, Rumania, and Italy all received parts of the old Austro-Hungarian Empire. Bulgaria lost much territory through the Neuilly treaty. The Ottoman Empire was almost completely dismembered by the Treaty of Sèvres, but Mustapha Kemal revolted, and forced more favorable terms in the Treaty of Lausanne in 1923.

The Great Powers recognized by treaties the independence of the new nations carved from Russia—Finland, Latvia, Lithuania, and Esthonia—and of Poland, which was restored from fragments of Germany, Austria, and Russia.

Measures to Promote Peace

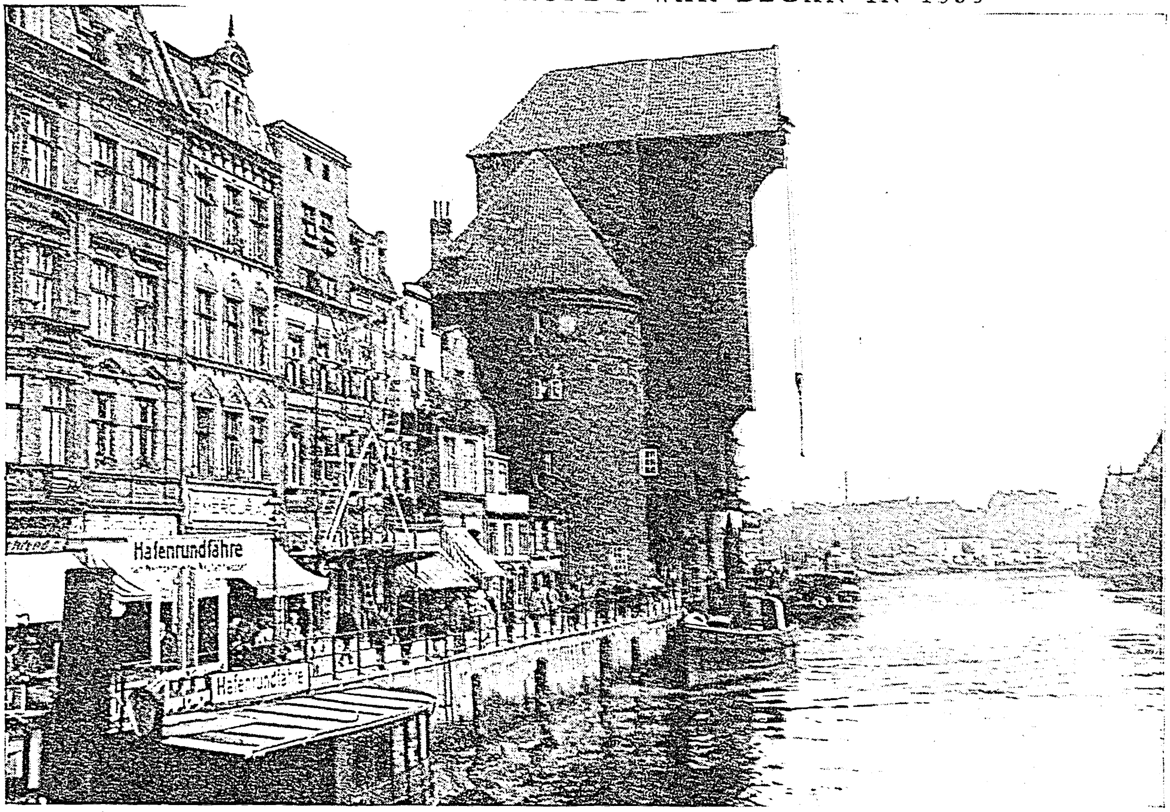
It was hoped that the new League system would later remedy the injustices of the peace settlement and meet new political problems as they arose. In 1921 the Permanent Court of International Justice was set up at the Hague to settle legal disputes, and to give opinions requested by the League. The League itself brought about peaceful arbitration of several quarrels between nations. In 1925 the major powers signed the Locarno Pact, agreeing to maintain their existing frontiers and reaffirming their willingness to submit all disputes to the League. In the Kellogg-Briand Pact of 1928 they further agreed to renounce war "as an instrument of national policy." Along with these pledges to maintain peace came widespread reduction in armaments. Conferences to limit naval construction were held in 1921–22 and in 1930 (*see* Navy); and in 1932 a general disarmament conference attended by delegates of 59 nations was held in Geneva

With such promise of lasting peace, Europe began to rebuild. From 1924 to 1929 business improved, and paper money was again given definite value. American citizens lent billions to Europe's states and cities for reconstruction. Huge programs were undertaken to build homes for workmen who attained new prosperity with improved industrial conditions and cooperative stores. Socialist parties became strong enough in Great Britain, France, and a number of smaller states to share in the government.

If Europe had not quickly resorted to its prewar political habits, this prosperity might have lasted. But a Concert of victorious powers, often ignoring the League, replaced the old Concert and kept Russia and Germany out. No great state would consider surrendering any part of its sovereign right to act unchecked in important matters. The political activity of the League was thus largely reduced to maintaining the superiority of the victorious states.

France, always fearful of Germany, alternately placated and repressed it. Soon after the war France helped to organize the Little Entente—Czechoslovakia, Rumania, and Yugoslavia—who also were bent on maintaining the Paris peace settlement. France formed alliances with them and with Poland, who had equal cause to fear Germany. With the German default on reparation payments in 1922, however, France felt strong enough to act alone. It seized the important Ruhr Valley, but then agreed to a reparation settlement (the Dawes Plan), which in turn was replaced by the Young Plan in 1929, granting more lenient terms. In 1925 Briand of France and Stresemann of Germany agreed on behalf of their states to respect their common frontiers, and to maintain the demilitarized zone in the Rhineland. They secured a guarantee from Great Britain and Italy of this settlement (the Locarno

DANZIG—WHERE EUROPE'S WAR BEGAN IN 1939



This peaceful-looking port on the Baltic Sea was the opening scene of a general war in Europe in September 1939, when Germany annexed Danzig and invaded Poland. Danzig had been taken from Germany after the World War of 1914–1918 and given the status of a "free city" under the protection of the League of Nations in order to provide Poland with a corridor to the sea.

treaties), and Germany was then admitted to the League. But France insisted on keeping Germany disarmed, and the Little Entente applied similar pressure to Austria, Hungary, and Bulgaria.

The Rise of Dictatorships

Parliamentary democracy often seems to function badly during wartime or other grave financial and economic crises, since important decisions cannot wait for debate. Such crises arose in Europe immediately after the war in some states, and everywhere after the depression beginning in 1929. Italy was the first important state to meet the crisis by abandoning parliamentary government for a dictator, Mussolini, who assumed power in 1922. His example was followed by the less capable de Rivera in Spain in 1923, by Pilsudski in Poland in 1926, and by Hitler in Germany in 1933. Austria and some of the Balkan states also were dominated by strong men. Once in power these dictators gave a unity of purpose and swiftness of action to their governments which the democracies had lacked. (*See* Dictatorship; Fascism.)

After Hitler's rise to power in 1933, Germany and Italy, at first individually and then together, began to upset the political structure of Europe that grew out of the World War. This structure—based on the power of the democracies working through the League—was repugnant to Hitler and Mussolini. The two dictators regarded their nations as the "have nots," wronged by the Versailles Treaty; France and England were the "haves," interested in maintaining the *status quo* because it worked to their advantage.

So Hitler in 1933 announced Germany's withdrawal from the League. He then threw off the restrictions of the peace treaty by rebuilding Germany's army, navy, and air force. Italy followed the German lead by invading Ethiopia (*see* Ethiopia). And as Mussolini's forces, despite League sanctions, neared their final victory, Hitler, in March 1936, again defying the treaty, sent troops into the Rhineland.

Rome-Berlin Axis Defies the Democracies

In October 1936 Italy and Germany announced an agreement to support their "parallel interests." This accord, known as the Rome-Berlin axis, was later widened by the inclusion of Japan in an "anti-Comintern" pact. Although ostensibly directed against Soviet Russia and communism everywhere, the pact was employed as a threat against the democracies. Thus, when the Spanish civil war broke out, Italy and Germany aided the rebels on the ground that they were fighting communism, but the immediate result was further to undermine French and British power.

With Italy checking France, Japan menacing Russia, and Germany forcing concessions from the nations of central Europe, the strong strategic position

THE CROWDED VEGETABLE MARKET AT COPENHAGEN

Every morning farmers bring their vegetables to this great market place and sell them directly to Copenhagen housewives. Progressive little Denmark, noted for scientific agriculture and farm coöperatives, remained neutral while its neighbors to the south were torn by the World War of 1914–1918. When Europe was again plunged into war in 1939, Denmark sought to maintain its long tradition of neutrality. But in 1940 the almost defenseless country was compelled to submit to occupation by the German army.

of the anti-Comintern alliance was evident. France was divided by internal strife (*see* France), and England was unprepared for a war in which she might have to defend herself at home, in the Mediterranean, and in the Far East. In 1937, therefore, France and England announced a joint willingness to satisfy the "legitimate grievances" of Germany and Italy.

Hitler Wins Austria and Czechoslovakia

Pursuing his advantage, Hitler in March 1938 sent his armies into Austria and made it a province of Germany. He followed this coup by precipitating a quarrel with Czechoslovakia over the German-speaking people of the Sudeten region. By threatening war, he drew Prime Minister Chamberlain of Great Britain and Premier Daladier of France into a conference at Munich in September 1938. There, backed by Mussolini, he gained their consent to the seizure of the Sudetenland. Resentment in the neutral countries against this assault on a peaceful nation was intensified by anti-Semitic riots in Germany. Hitler's reply was to seize most of what remained of Czechoslovakia. Hungary, now a member of the anti-Comintern pact, took the rest (*see* Czechoslovakia).

Germany and Italy Help Franco Win Spain

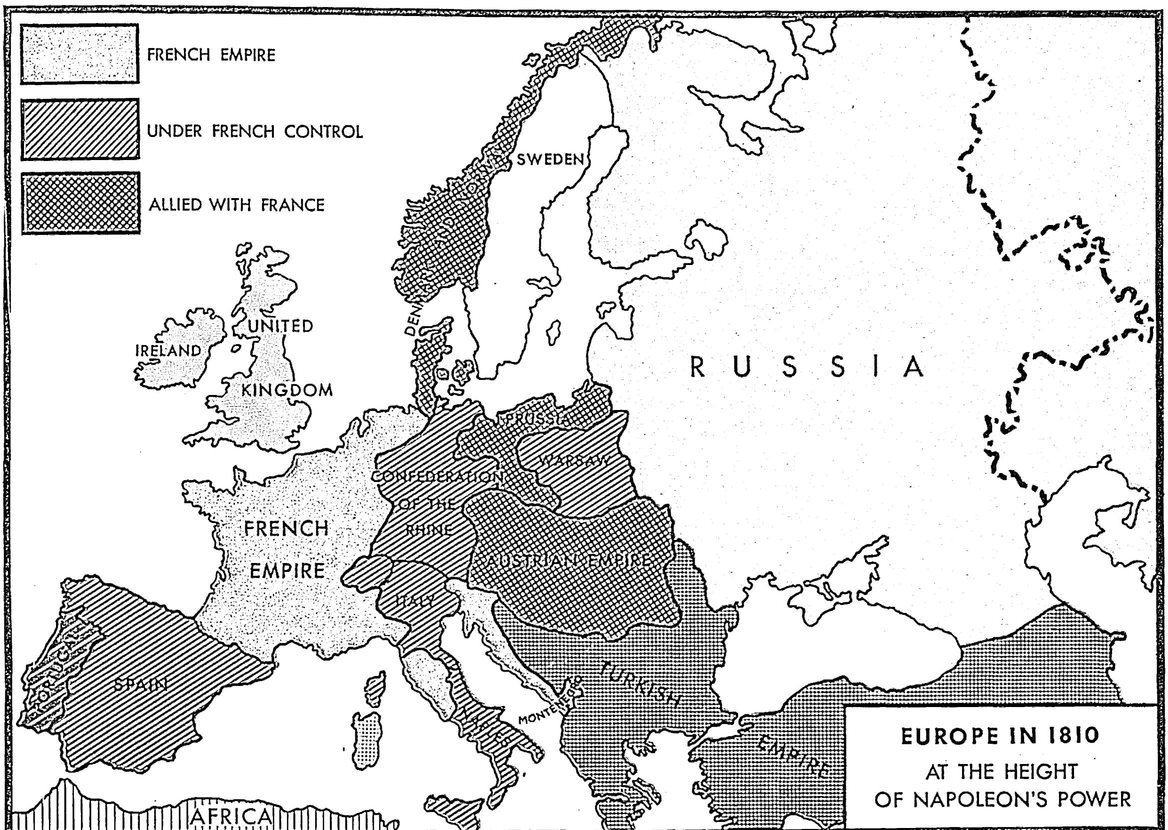
At the same time, the continued intervention of Italy and Germany in Spain finally helped to break the resistance of the loyalist armies, and in March 1939 General Franco's army marched into Madrid. Franco then established a fascist dictatorship and joined in the anti-Comintern pact (*see* Spain).

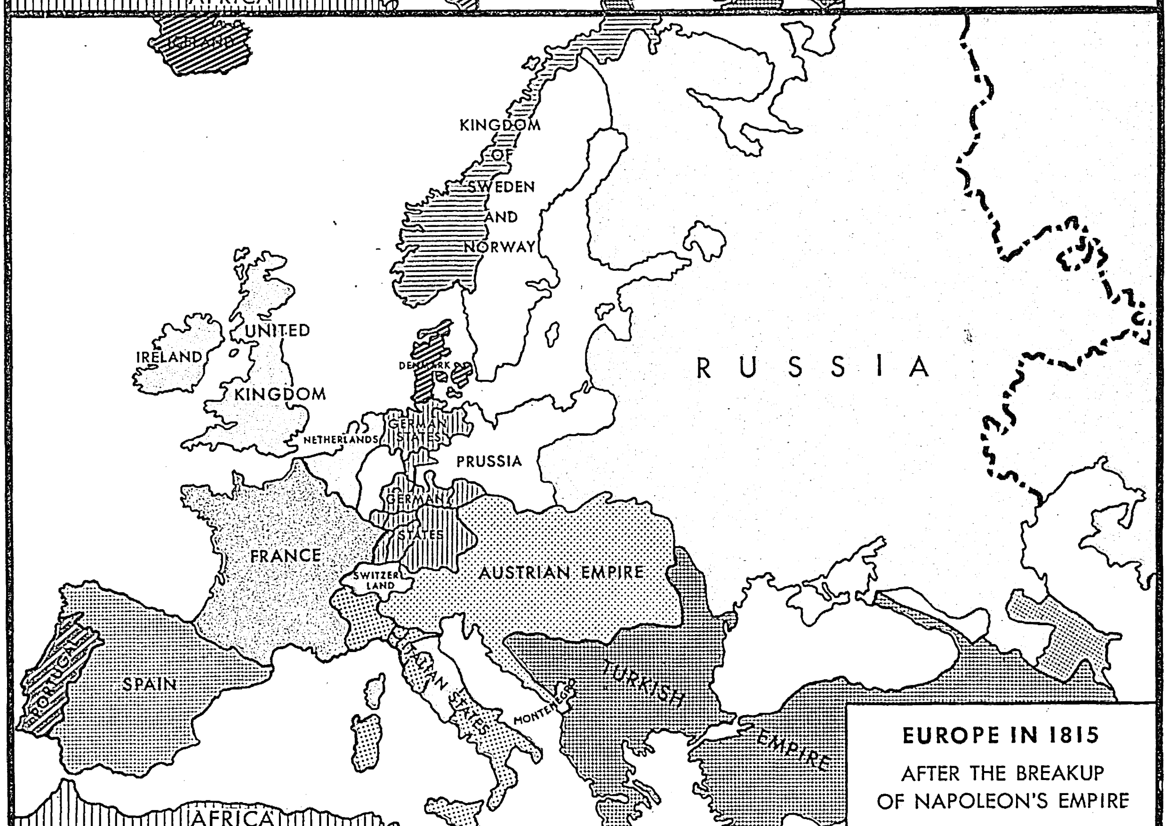
Mussolini followed the victory of his troops in Spain by asserting Italy's demands for French territory in North Africa. Hitler, after the conquest of Czechoslovakia, increased the threat of a German drive to the east (*Drang nach Osten*) by extending Germany's economic influence in southeastern Europe.

Toward a Second World War

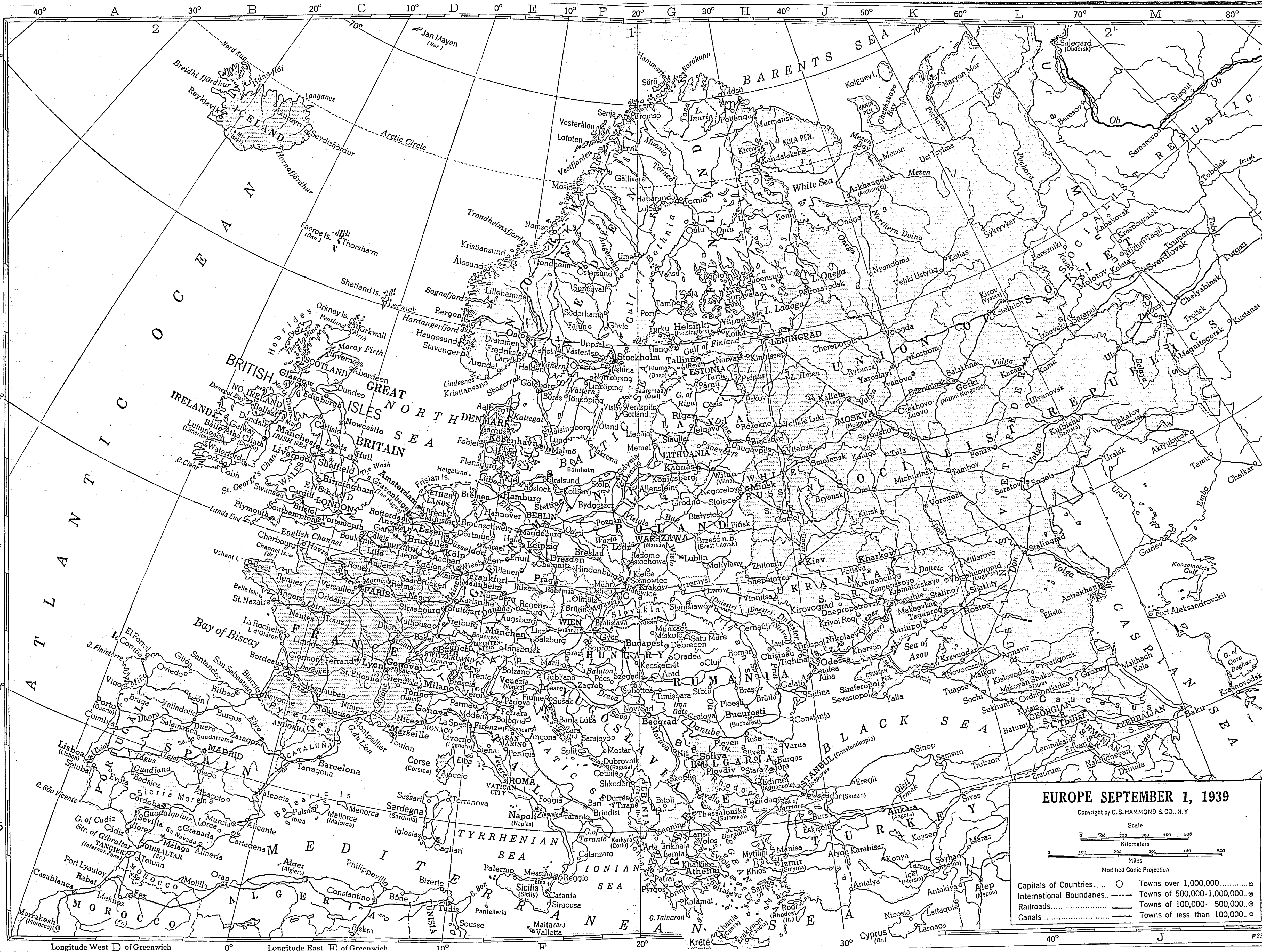
These new threats to the security of France and England caused Chamberlain and Daladier to abandon their policy of appeasement. In April 1939 Chamberlain, supported by France, announced that England would guarantee the independence of Poland, Rumania, Greece, and Turkey. But even as this new policy of resistance was forming, Italy annexed Albania.

Now Europe was plainly headed toward war. In defiance of the Anglo-French guarantee to Poland, Hitler demanded Danzig and a strip across the Polish Corridor linking East Prussia with the rest of Germany. Poland, with Britain's support, rejected these demands. Hitler then made an astounding move. Profiting from the failure of the democracies to draw Russia into an alliance, on August 24 he concluded a nonaggression pact with the Soviet Union. There were desperate last-minute British efforts to avert the impending war, but Hitler would not be swayed. On September 1 he sent his armies into Poland. On September 3 England and France declared war on Germany. (For the background and events of the war, *see* World War, Second. *See also* **Europe, History** in FACT-INDEX at the end of this volume.)

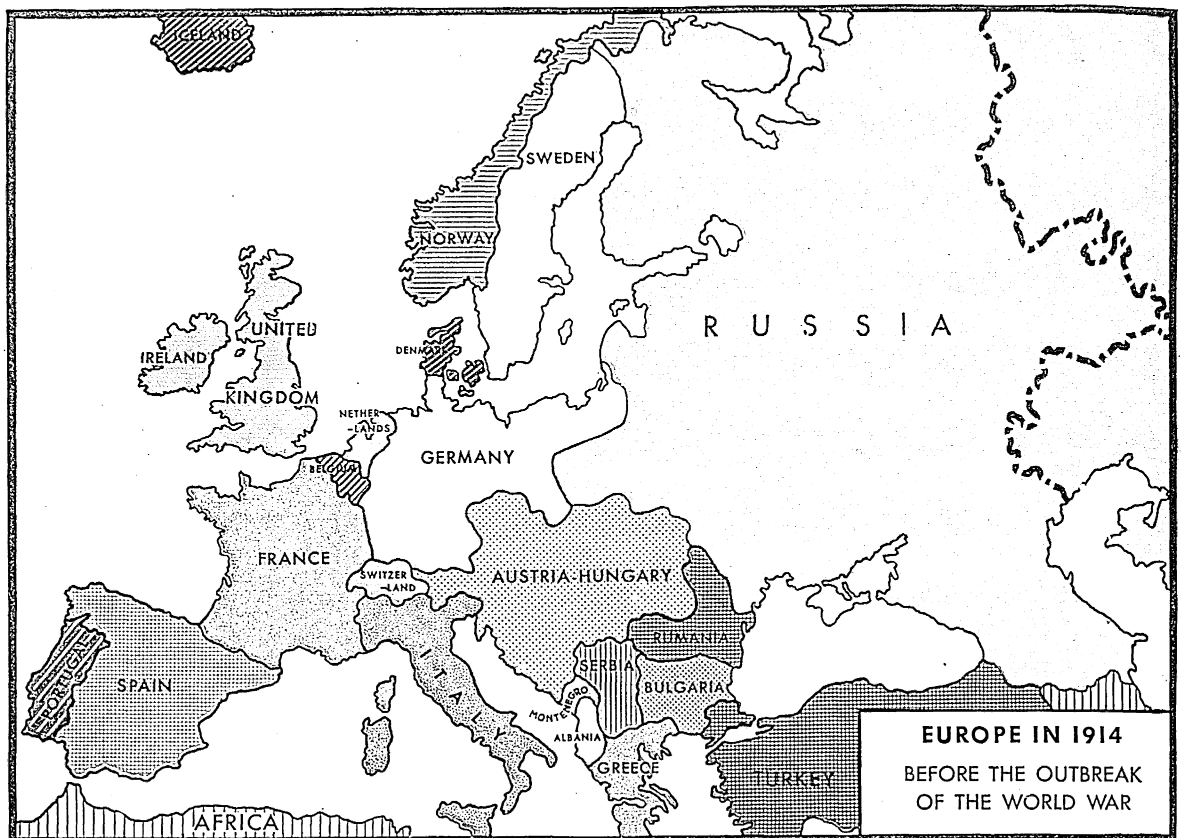


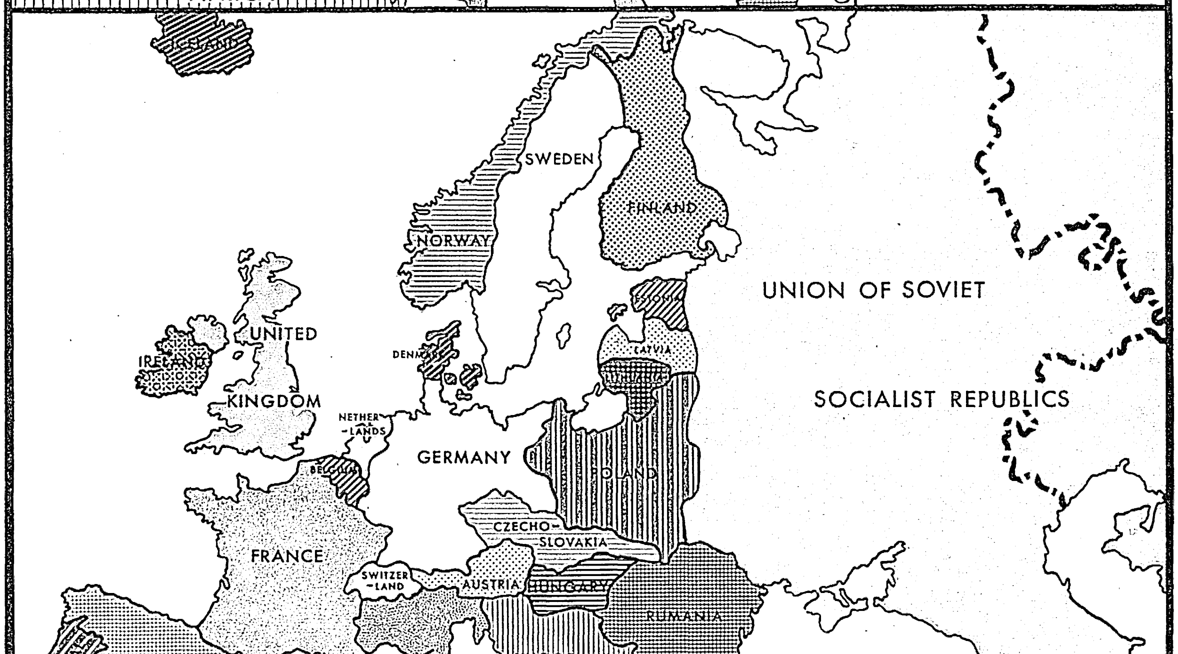


Twice, in little more than a century, the map of Europe has been transformed by tremendous conflicts. Here we see how nations grew and shrank, were born and died, in the convulsions of the Napoleonic period. Now turn to the third page following.



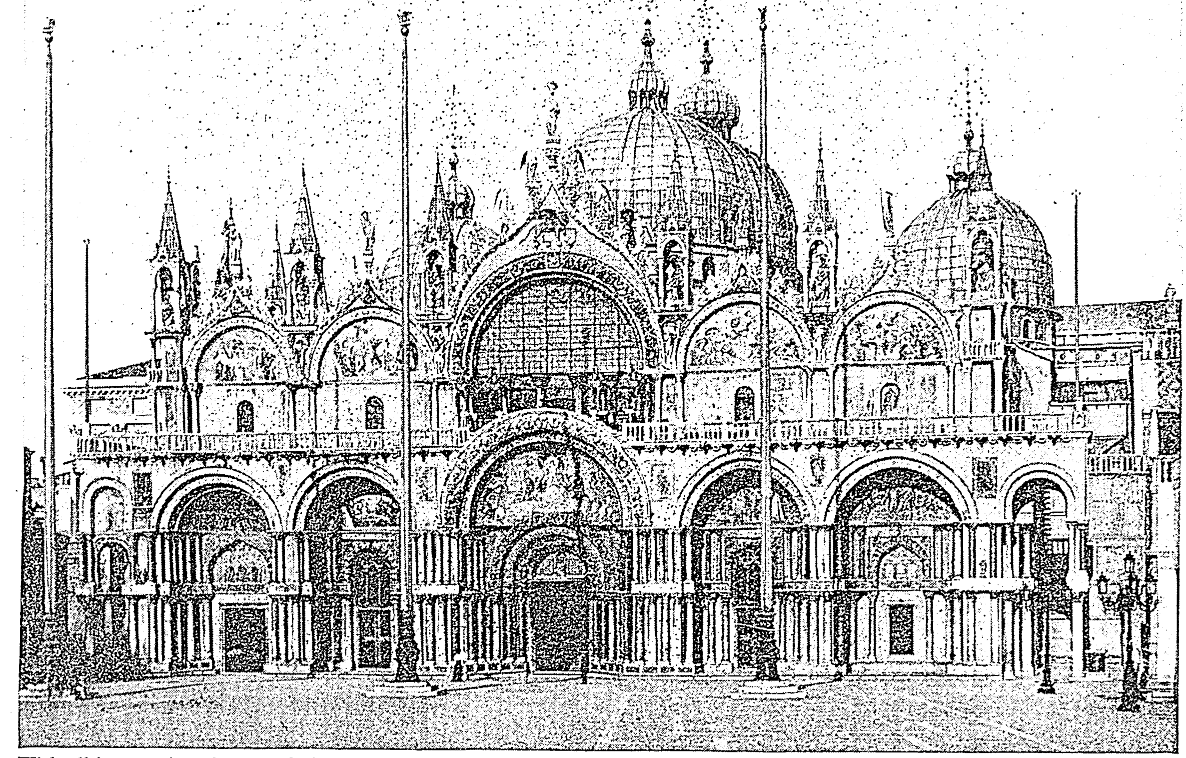
EUROPE SEPTEMBER 1, 1939
Copyright by C. S. HAMMOND & CO., N.Y
Scale
Kilometers
Miles
Modified Conic Projection
Capitals of Countries
International Boundaries
Railroads
Canals
Towns over 1,000,000
Towns of 500,000-1,000,000
Towns of 100,000- 500,000
Towns of less than 100,000
P3311
Longitude West D of Greenwich
Longitude East E of Greenwich
ATLANTIC OCEAN
BARENTS SEA
NORTH SEA
BALTIC SEA
BLACK SEA
CASPIAN SEA
MEDITERRANEAN SEA
TYRRHENIAN SEA
IONIAN SEA
White Sea
Bay of Biscay
Sea of Azov
Arctic Circle
English Channel
ICELAND
BRITISH ISLES
GREAT BRITAIN
IRELAND
NORWAY
SWEDEN
FINLAND
DENMARK
ESTONIA
LATVIA
LITHUANIA
POLAND
GERMANY
FRANCE
SPAIN
PORTUGAL
ITALY
SWITZERLAND
HUNGARY
RUMANIA
YUGOSLAVIA
BULGARIA
GREECE
ALBANIA
TURKEY
MOROCCO
ALGERIA
TUNISIA
UNION OF SOVIET SOCIALIST REPUBLICS
RUSSIAN S.F.S.R.
WHITE RUSSIAN S.S.R.
UKRAINIAN S.S.R.
GEORGIAN S.S.R.
ARMENIAN S.S.R.
AZERBAIJAN S.S.R.
Reykjavik
LONDON
PARIS
MADRID
Lisboa
BERLIN
WARSZAWA
Praha
WIEN
Budapest
Bucuresti
Beograd
Sofiya
ROMA
Athenai
Tirane
Oslo
Stockholm
Helsinki
København
Tallinn
Riga
Kaunas
MOSKVA
LENINGRAD
Kiev
Kharkov
Stalingrad
ISTANBUL (Constantinople)
Ankara (Angora)





Like the Napoleonic wars, the World War of 1914-18 remade the face of Europe, creating new nations and destroying others. On the preceding two pages you see Europe as it is today, and on the third page back, Europe in Napoleon's time.

In MOTHER EUROPE'S TREASURE HOUSES



With all its stately palaces and picturesque canals, the pride of magnificent Venice is nevertheless the Cathedral of St. Mark, with its graceful Byzantine domes, its rich ornaments, and its wonderful mosaics. This church is a beautiful example of the art treasures that the loving care of their peoples has heaped up in the countries of Europe during past centuries.

AMERICANS who go to Europe find it like a treasure house, packed with wonderful and beautiful things. No power of words can bring into the mind the vision of the glory that men have put into this continent where our modern civilization has chiefly developed. There have always been men striving to give Europe beautiful things. There have always been men and women who have spent their lives in dreaming of beautiful things and of impressing their vision in some way on the minds of their fellows and of all who shall come after them. Never for long has the chain been broken; here and there in the darkest ages some man, faithful to mankind, was copying a precious manuscript in his monastic cell; some poor mason was chiseling a rough piece of marble until there grew out of it the face of a child; some humble artist was painting a picture on a little church wall; some builder was shaping a pinnacle for a cathedral spire; some worker in wood or iron was making a little casket that we look at with wonder even now.

Perhaps first of all the traveler will find his way to Italy; and those of us who have yet to walk through these old Italian cities, like a vast museum of all the past, have in store the greatest treat the world affords for travelers. For in Italy we walk down a street in Florence and look up at a thing that Michelangelo put there; we go through a door in Rome and see the work that Raphael did, as fresh as if he had left it yesterday; we steal quietly through the Old World streets of Pisa and climb the tower Galileo climbed when he wrote a new page in the Book of Knowledge; we meet the Emperor Augustus addressing his soldiers, clad in his suit of mail as the artist must have seen him. We see Marcus Aurelius on his horse at the top of the Capitol Hill in Rome; we go down into the Forum and stand on the spot where, tradition says, Mark Antony delivered his oration over Caesar's body.

Amazing it is, as we go about Europe, to find ourselves in touch with wonders that stood high in the world before America had any place in history. We go down to Naples and marvel at Pompeii, looking out across the ruined streets of a city destroyed in a night, soon after Christianity came into the world. There we walk through streets the Roman nobles walked through on their holidays; we see their gardens and

their fountains, sit in their rooms and in their theaters. We see the expression on a dead man's face as Death came to him in that awful night, for there the man himself is lying still, turned into solid stone, with every muscle of his face precisely as it was.

In Paris, a thousand miles or so from Pompeii, we stand beside the Venus of Milo, one of the incomparable treasures of the world, a glorious figure of womanhood, older than Christianity itself. Twenty-one centuries have passed since one of the world's great artists chiseled this noble figure in ancient Greece, and it is here today in the Louvre of Paris, a treasure house that has no rival on the earth. It would take us two hours to walk through this great place without stopping, and no two hours in any lifetime could be more filled with wonder and beauty.

Even if it were empty, this palace of art would be famous for its own sake. Some of its foundations are as old as Magna Carta; part of it was built by King Francis I, who was taken prisoner in war with Spain in 1525; and the last gallery to be finished, much nearer our own time, is not unworthy of the rest of this stately home of art. This gallery alone has 16 statues of great Frenchmen and 63 groups of allegorical statues. The gallery of Apollo, 200 feet long, is one of the finest halls in the world, paneled with priceless tapestries; it has in it all that is left of the crown jewels of France.

The Art Treasures of the Louvre

The treasure of the Louvre is beyond all calculation. There is one glorious collection worth $4,000,000 housed in a little room decorated at a cost of $50,000, and it was given to France by a great family that had its rise in Germany. There are 3,000 ancient sculptures, 2,500 pictures, and many thousands of drawings by the great artists of all nations. There are the best Raphaels in Europe, and Titians in abundance. There are six rooms full of antiquities from Assyria and Phoenicia, five rooms full of sculptures of the Middle Ages rescued from ruined churches at the time of the French Revolution, five rooms that speak to us of "the glory that was Greece and the grandeur that was Rome," two halls with relics of the Egypt of the Pharaohs, and five rooms filled with the glorious statues that French sculptors are giving to the world in our own time.

And outside, in her noble streets, Paris is a glory to see, with all her marvelous gardens, her long lines of statues, her rare and beautiful gateways, her glorious towers and domes. No traveler forgets them once he has found them, but it is strange that some of the greatest architectural glories in the world are tucked away and hard to find. One of them is the little blue chapel of Sainte-Chapelle, tucked away among the Paris Courts of Justice, where for the last 600 years it has drawn within its doors those travelers to the capital of France who seek out its quiet places. It reminds us of that other little blue chapel far away in Rome, buried underneath the streets, where lies St. Cecilia, the wife of a Roman soldier in the days when Christianity was struggling to make its way into Europe. She converted her husband and her judges, but she was murdered herself, and she has lain here in this lovely little place hidden below the streets of Rome for a thousand years and more.

The Beautiful Cathedrals

Words fail to describe the wonder of those greater buildings set up all over France—her marvelous Gothic cathedrals. How many lives of men, how much planning and toiling and self-sacrifice, have gone to the setting up of these cathedral towers and fronts which never pass from the vision of the traveler who once has seen them? These mighty monuments, almost too great for us to grasp, were built up piece by piece and carved out inch by inch; one touch and then another, till a man's life was done and another man took his place; one stone upon another till the topmost height was crowned. So year by year, generation after generation, from century to century, man laid up treasure upon earth. So arose Notre Dame in Paris; so arose the cathedral of Tours; so grew that majestic structure of Reims, which suffered frightful damage during the World War; so the face of France was adorned with the glory of cathedrals such as that which Ruskin called "The Bible of Amiens."

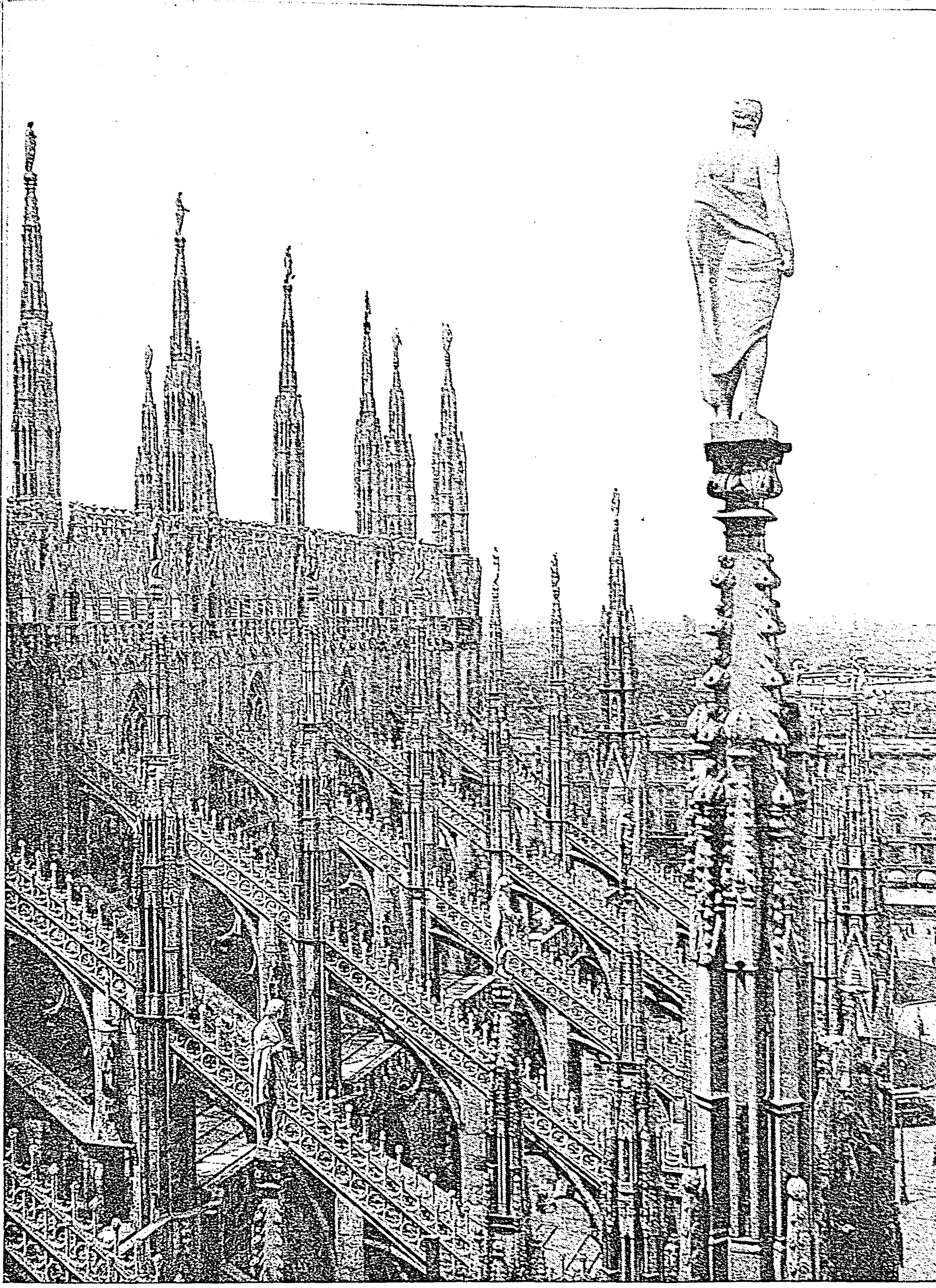
We do right to worship Nature and to love the mountain peaks, but he is less than human who can look at these monuments of men and not be thrilled with pride; he is less than human who, coming into the world for a few short years and finding these things here, can blot them out of the world as he passes through. They can never be replaced.

The treasures left behind by 60 generations of men are stored in our museums or set up in our open streets —for men have set up priceless things for the wind and rain to beat upon, trusting that the world would care for them.

Britain's Great Museum, Epitome of Civilization

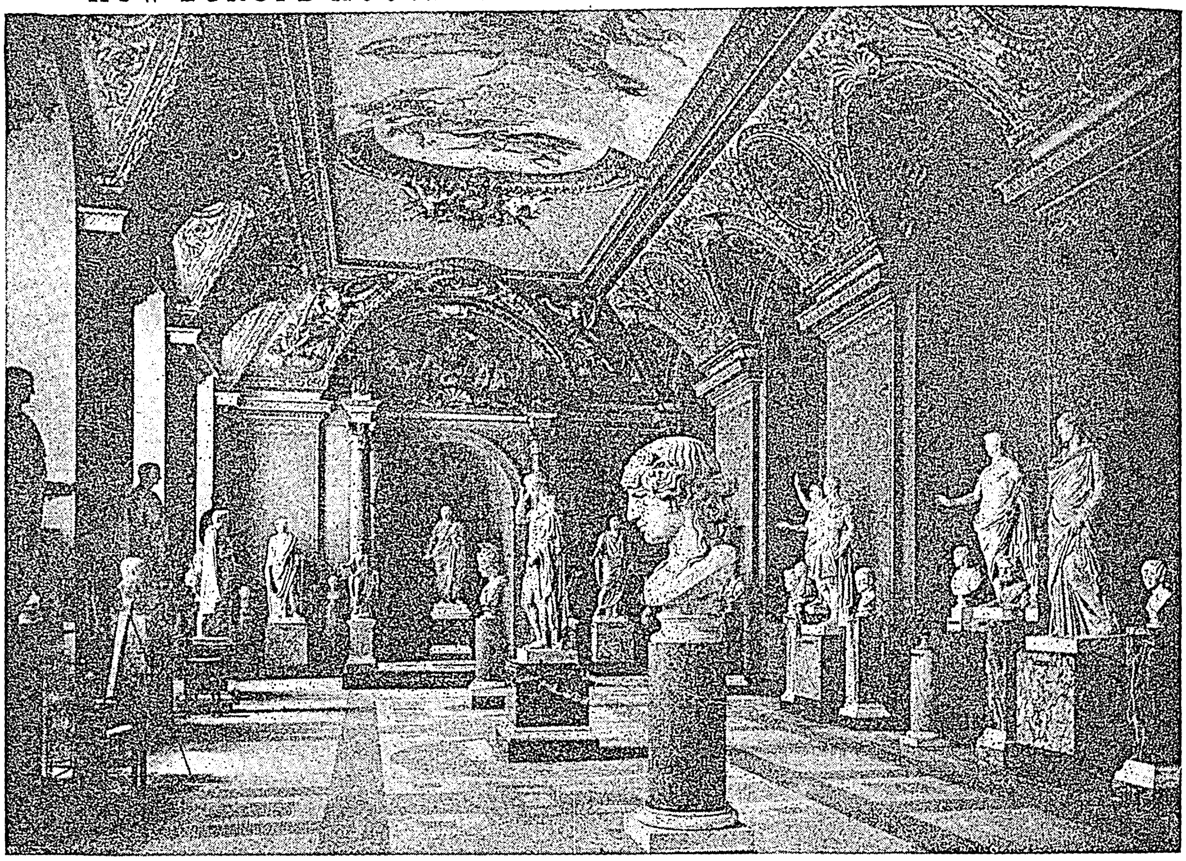
It is one of the astonishing experiences of the traveler on his first visit to Europe to find himself in such a place, let us say, as the British Museum in London, a sort of kingdom of all times and all places. You think of Rome, and, lo! you pass through a high archway into the company of the Roman Emperors, all chiseled here in marble by men who knew them and saw them pass. You think of the Pharaohs of ancient Egypt, and upstairs you find them sleeping. You wonder how the first men killed wild beasts; here are the things they killed them with. You ask how the early men spent their time; here are the things they made with their hands. Here is the Magna Carta which King John was forced to grant. Here is a penny like that which was handed to Jesus when they asked if they should pay tribute to Caesar. Ask for a letter from Oliver Cromwell, and it will be given you; close by you may read one from Washington. Ask for a letter from a king of Babylon, and it is here. Here are things that filled all men with wonder when wild beasts roamed where London stands. Here is most of what is left of the Seven Wonders of the

THE CHURCH WITH NINETY-EIGHT SPIRES



Nowhere in the world is there on one building a greater wealth of spires and statuary than that which enriches Milan's late 14th century cathedral. The closer we get the more beautiful they are; for every detail, almost every stone, has been wrought with loving care into a beautiful ornament. This view shows how this ornamentation has been carried out among the "flying buttresses" which support the walls of the cathedral. There are altogether 98 of these spires on the church and more than 2,000 statues.

HOW EUROPE HOUSES HER PRECIOUS ART COLLECTIONS



Here is the famous "Hall of Augustus" in the Louvre Museum in Paris. The Louvre was formerly a palace of the kings of France, and its interior decorations reflect the elaborate richness and beauty of the Renaissance period. This room is named from the famous statue of the Roman Emperor Augustus in the niche at the far end. Most of the other statues date from the days of the Roman Empire.

ancient world—except for the Great Pyramids, that still stand in Egypt.

It is in London that we find ourselves in the presence of some of the noblest achievements of antiquity. In the British Museum we look on things that astonish us by their strength.

We find the treasures of the Bronze Age, when men first found the way to work in metal, and we see the tools and ornaments they used; we see such things as that beautiful trumpet found in Ireland, a remnant of days before there was a single page of Irish history.

We find the work of the Iron Age man. We are in the Iron Age still, for it will surely never pass, but it is thrilling to look on things that were made and used by the people Julius Caesar found in Britain.

We look on the work of men of Babylon and Assyria; we see the pictures from the walls of Egyptian houses and tombs; we catch a sense of their humor, we see in them something of the mystery and magic of the lives of men in Pharaoh's day. We can touch and handle such things as Abraham and Isaac and Jacob must have touched.

And we walk about among the art treasures of Greece, in and out among her sculptures, with all their vividness and beauty, compelling us to pause and think how great civilization was a hundred generations ago.

We come face to face with life in Rome. We see the flowing costumes of her soldiery and people; we see the games they played.

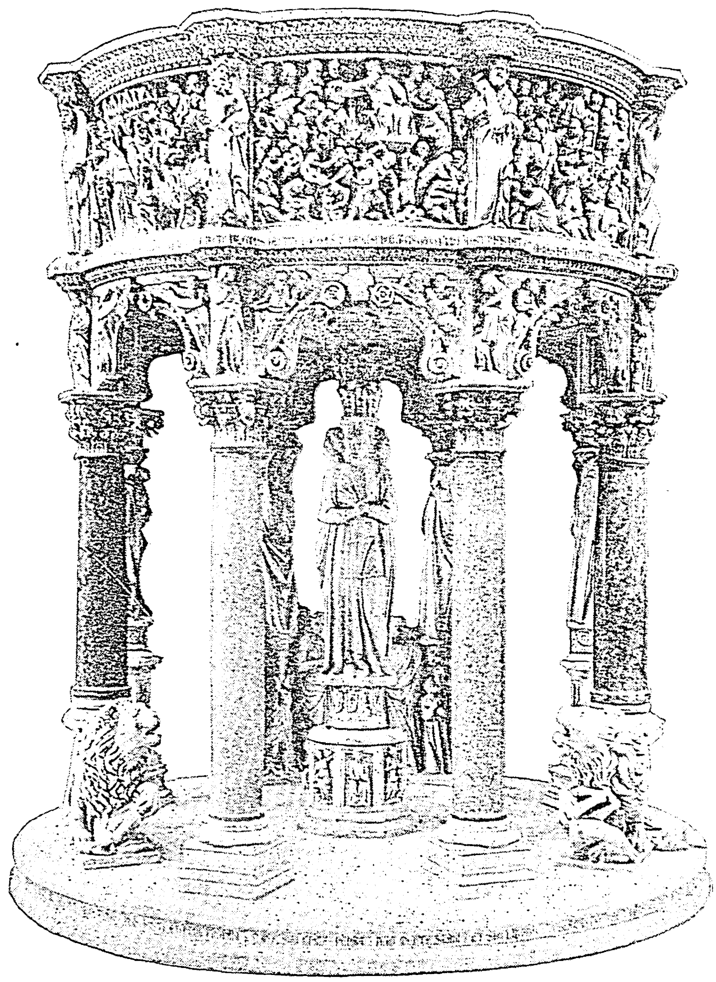
The Old World and Its Memories of the Past

Wherever we go in the Old World cities we find the memory of the past, things that have survived the wreck of time. There are places in which Time's pendulum seems hardly to have swung at all—such places as that quaint old printer's shop in Antwerp, which remains to this day as the printer left it three centuries ago; or as that merchant's house in Bergen, which is hardly altered since the merchants of the Hanseatic League conducted their business there; or as that old house in London crammed with the treasures of old Sir John Soane, all left as he bequeathed them to the world nearly a hundred years ago. Here is one most precious thing, the sarcophagus in which lay the father of that Pharaoh Rameses who filled so great a page in Egypt's history. This lovely stone coffin, by which Rameses the boy must have stood to take leave of his dead father, lies in the cellar of a house in Lincoln's Inn Fields in London, passed by thousands every day who little dream that it exists.

So it is everywhere. The streets of Paris, of Rome, of Brussels, of London, of Berlin—and Munich and Dresden and Vienna and Budapest—have in them many a touch of the human genius of the past; and if we come to some of Europe's more ancient places we find, alas, the mark of war across these ancient wonders, and glory lies in ruin. How priceless is the treasure that war in Europe has destroyed! It is to war that the world owes the destruction of one of the noblest buildings ever set up in Europe—the Parthenon which crowned the Acropolis of Athens. Here came Socrates and Plato and Aristotle; here came Demosthenes; here, to this most perfect monument of ancient art—begun four centuries before Christianity, with 100 columns, 50 life-size statues, and a frieze more than 500 feet long—came all the great Greeks whose names are written forever in the history of human thought.

But neither the dignity of association with these great names, nor the love of the past, nor the quality of greatness in itself, is anything to the god of war, who must be fed with human lives and the finest products of the human mind; and so the Turkish army stored its powder in the Parthenon, and an officer in the opposing army of Venetians fired a shell which broke in two the architectural pride of Athens and the crowning splendor of the most famous hill in the history of civilization. To this day the ruin stands to warn us all against the folly which destroyed it. One of the stories the traveler brings away from Rome is of the pope who tore the lead roof from the Pantheon to make into cannon-balls. It is the oldest building in the world that still stands as it stood the day the builders left it; and it dates from Augustus Caesar. But no thought of this held back the pope who wanted cannon-balls, nor even the thought that Raphael sleeps under this roof stayed his destroying hand.

ONE OF ITALY'S RICHEST GEMS



This pulpit, which was made by Giovanni Pisano for the Cathedral at Pisa about 1310, is one of the triumphs of early Italian Renaissance sculpture. During the rebuilding of the Cathedral after the fire of 1595 the pulpit was broken up. Three-quarters of a century ago a devoted art-lover studied the surviving fragments and made from them a model of the original. At the end of the World War it was decided to reconstruct this magnificent monument. After years of patient labor, the restoration was completed in 1926, and Giovanni Pisano's masterpiece again adorns—after a lapse of three centuries—the Cathedral for which it was built.

Everywhere the war god is the same. A cannon-ball has fixed itself in a tree in the garden of a church in Rome, narrowly missing the destruction of a sacred casket of the 13th century; and as we go through a famous Roman palace we find a cannon-ball still imbedded in the staircase where the soldiers sent it, aimed at a spot around which are rooms crowded with precious things. It was in war that Raphael's tapestries were injured beyond repair. Made at Brussels, in wool and silk and gold, from cartoons among the most admirable of all Raphael's works, they were destined for the Sistine Chapel at Rome; but war robbed Michelangelo's chapel of this priceless glory, for the tapestries were captured and sold in Genoa, and today they have but a remnant of their original value.

What a glorious place, how far beyond the power of words to describe, is this center of the treasures of Rome, the Vatican. Here, in this unparalleled palace, where popes have lived for 1,400 years, where Charlemagne lived on his visit to Rome in the year 800, is gathered together incalculable treasure. Here, for all the ages of the world to see, Michelangelo left his noblest work; here Raphael crowded spacious walls with his immortal figures. The traveler leaves the Vatican

with an overwhelming sense of glory; nowhere else in the world is brought together such a boundless wealth of astonishing things as in this building, which we think of afterwards as a sort of marble forest, so enormous are the distances under its roof. One half of one of its corridors has 700 marble sculptures; the other half has 5,000 precious inscriptions from pagan and early Christian times let into the walls. Another corridor has some of the first maps of the world built into the sides; others are packed with visible glories of the Roman Empire that are unmatched anywhere.

The length of the Vatican is given as 1,150 feet and the breadth as 167 feet; it has 8 grand staircases, 20 courts, and thousands of rooms. In one little beautiful hall in this home of the popes are 50 statues and 90 busts unequaled in interest anywhere else in the same space. They include Augustus speaking to his soldiers; Titus, the conqueror of Jerusalem, and his daughter; Diana beholding the sleeping Endymion; Demosthenes with a scroll in his hand, as Athens knew him so well; a group of 16 playing children; a mosaic with Diana of the Ephesians; Hadrian, the emperor who built the great Roman wall across Britain; Mark Antony, who loved Caesar; and old statues of poets, athletes, barbarian chiefs, and other figures who seem to be stepping out of the ancient world as we stand and look at them. Trajan, too, is in this precious little hall—Trajan, in whose forum there still stands the marble column with a spiral band winding around it carved with 2,500 human figures.

And there stands at the top of a staircase in Rome the beautiful tomb of St. Helena, made from one immense block of porphyry, with the triumph of Helena's son Constantine carved upon it. It has been in Rome 750 years, and lay in fragments in a cloister from 1600 to 1750. But somebody cared enough for this stately tomb to keep several men seven years in restoring it and polishing it; and it is one of a thousand impressive pieces of masonry, so beautifully carved that, though they are but tombs, they seem to be almost alive.

Our Rich Inheritance of Art

Who can travel through Europe and look on all these things of beauty and not be grateful to all these countless artists of the past, thousands of them poor and unknown men, who left us this work of their hands? Everywhere, in all the ages of the world, men have sought to leave for us something we could look at, something it would lift up our hearts to see. We think of Nicolas Poussin, the French painter of the 17th century, who could live nowhere but in Rome, and devoted his life to bringing before our eyes the great figures of classical history and Greek mythology. He would study broken statues and pore over ruins to get the secret of their beauty, and carry it on as a mother carries on the breath of life; and he would pick up a handful of earth, with fragments of lime and grains of porphyry and marble, and would hand it to a Roman friend, and bid him "Take this to your museum, and say, 'This is ancient Rome.'"

So men have loved the past and saved it for us, that we might love it too.

They have built windows of transparent stone, like the stone of which Nero built a temple, which had no windows yet was light as day. They have made cathedral gates which compel all men to stop and gaze upon them as they pass, like the gates of Ghiberti, of which Michelangelo said that they were "fit to be the gates of heaven." They have translated into marble the joy and praise of the Psalms of David, as in the singing choir of Luca della Robbia (in Florence), worthy of immortality.

They have given us quiet cloisters in cities, where men can put off the stress and strain of the working day, and walk as in another world. They have built up temples and filled them with solemn splendor; have laid out gardens fit for angels' feet to walk in. We may sit for hours enthralled by the charm of some small thing; we may live for years in the cities men have made and never tire of their beauty.

A Charm that Never Grows Old

And what amazes us most of all, perhaps, is that these great beautiful things, often of astonishing strength and gigantic size, have a marvelous delicacy of touch and a wondrous charm, and seem as fresh as if they had left the sculptor's studio yesterday. Yet we know that all these things are ages old, and there comes to us, as we look at them, a sense of the continuity of the world.

One generation goes and another comes, and the work of each lives on. One man thinks a beautiful thing, and in ages to come other men read and other men look, so that, long after the thinker and the artist have passed beyond the memory of the world, the things they said and the things they made move the hearts and help to shape the minds of men.

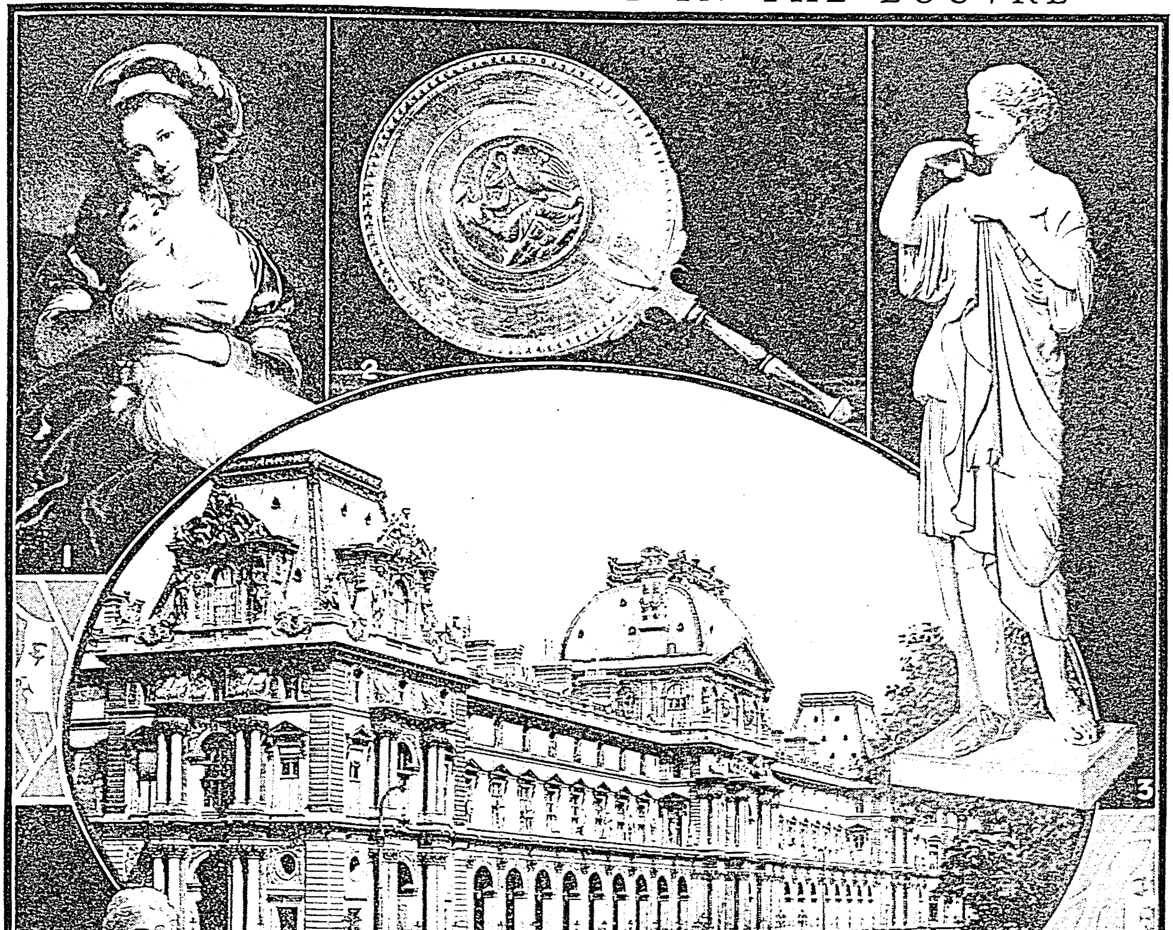
Wonderful it is that so much of the ancient world remains, and wonderful indeed that so much remains with its charm unspoiled! We must thank our Mother Earth for most of it, for she has covered up our treasures with the dust of centuries. She guarded them from Goth and Hun, from the wearing hand of Weather and Time, and nearly all our monuments of ages past have been rescued from the grave in which the earth protected them.

A building falls in ruin. The dust of ages covers it, and other men in other times discover what was lost. So there is preserved for us the evidence of life, the handicraft of men and women, from the days when human history began.

Imagination grows on things like these, and the mind runs back and thinks of what the world has been and of what mankind has seen since all these things were made.

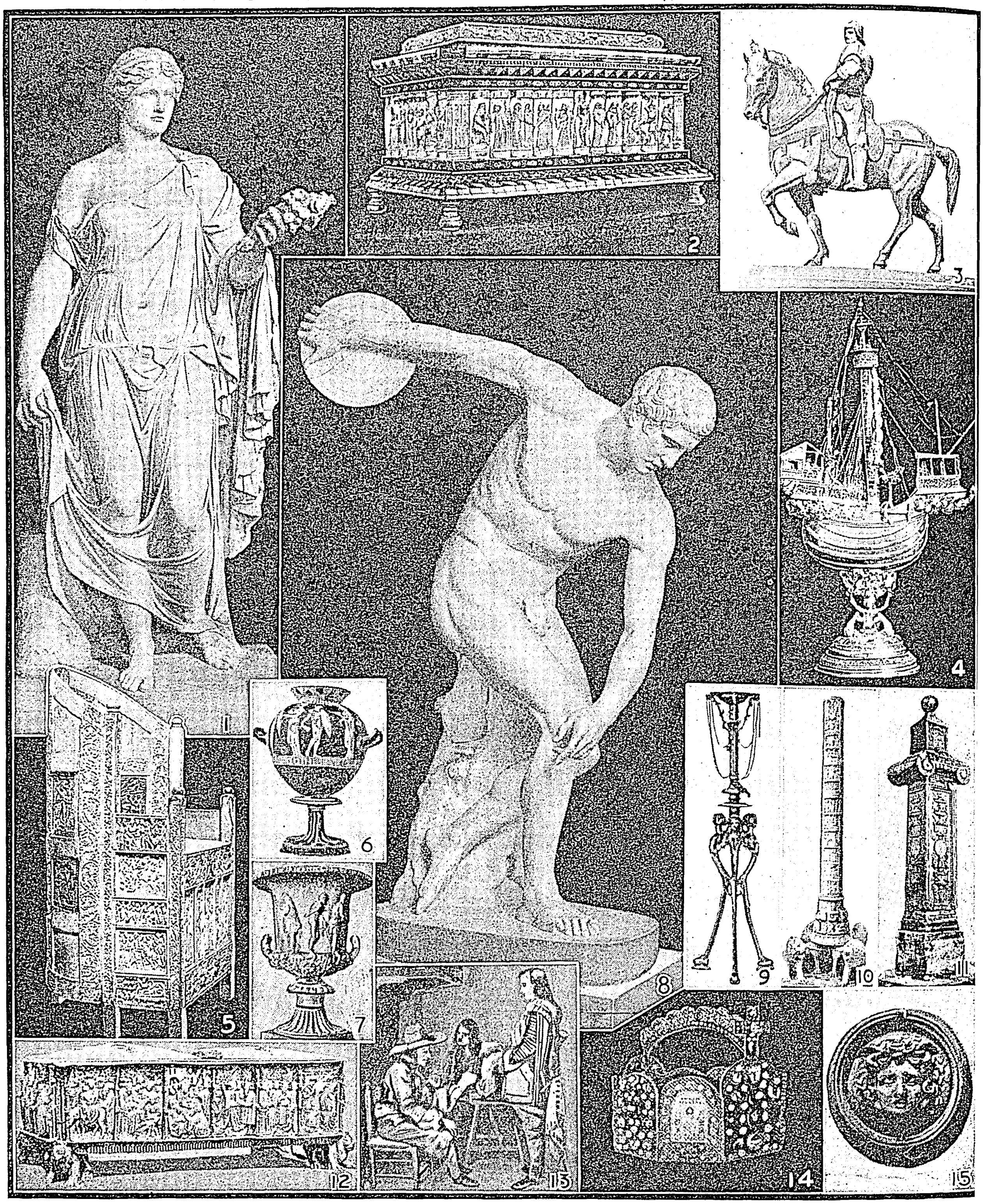
We can hardly conceive the wealth of all this treasure that the toil of men has laid up for us. The great European museums are literally filled with treasures of beauty and wonders of antiquity far older than the United States. In them we walk for mile upon mile, and seem to be walking through the pages

ARISTOCRATS OF ART IN THE LOUVRE



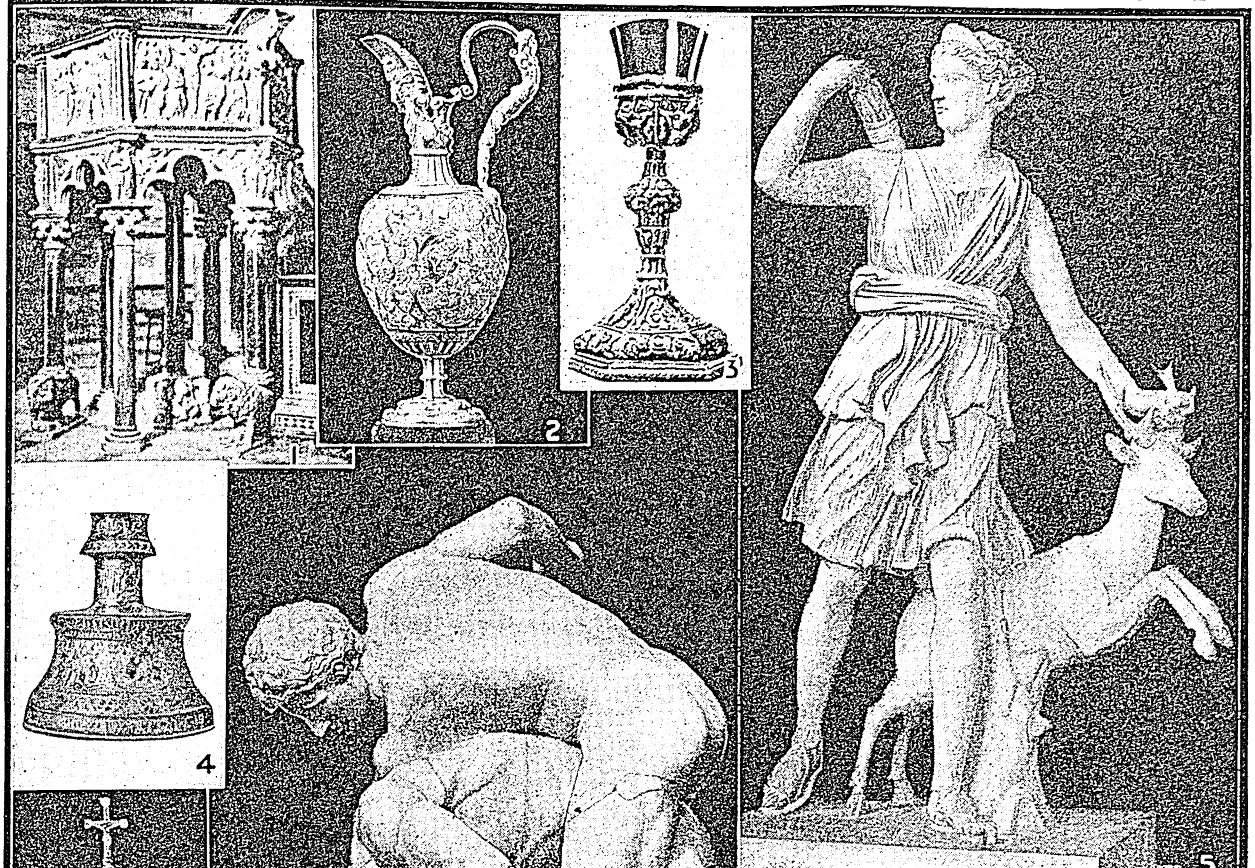
The Louvre in Paris, once the palace of French kings, possesses one of the greatest collections of art treasures in the world. The central view (4) shows the north façade, where the Louvre faces the Tuileries gardens. The other pictures show a few of the more celebrated treasures: (1) Elizabeth Vigée Lebrun's portrait of herself and daughter; (2) ancient mirror; (3) ancient statue, the 'Artemis of Gabii'; (5) Venus de Milo; (6) Borghese vase; (7) 'La Gioconda', or 'Mona Lisa', by Leonardo da Vinci.

EXAMPLES OF THE MAGIC OF THE ARTIST'S SKILL



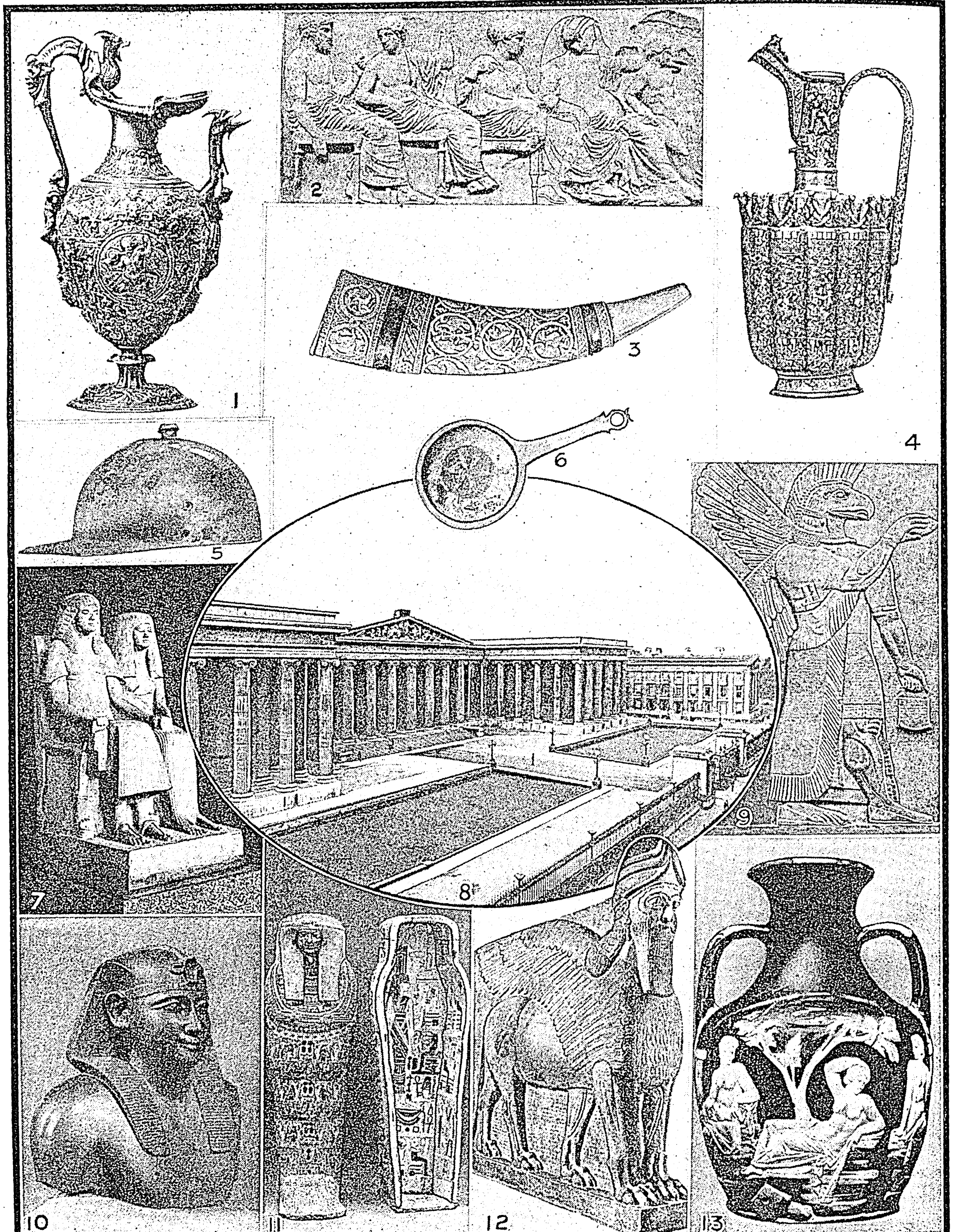
Although all Europe is a storehouse of beautiful objects, Italy is by far the most munificently provided. This is why the examples shown above include more works from Italy than from any other country. The objects are as follows: (1) Greek statue of the goddess Flora, in the National Museum, Naples; (2) ivory casket, Catania; (3) equestrian statue of Captain Colleoni, by Verrocchio, Venice; (4) censer, Church of St. Anthony, Padua; (5) ivory chair, Ravenna cathedral; (6) ancient vase, Naples; (7) vase, Florence; (8) 'Discus Thrower', Vatican, Rome; (9) and (10) candlesticks; (11) column; (12) beautifully carved casket, Milan; (13) painting, 'The Order', by Metsu, Dresden Art Gallery; (14) crown of Holy Roman Empire, 14th century; (15) door knocker recovered from the ruins of ancient Pompeii.

FROM THE ENDLESS VARIETY IN EUROPE'S TREASURY



(1) Pulpit in Baptistery at Pisa by Niccolo Pisano; (2) silver pitcher, by Benvenuto Cellini; (3) silver vase; (4) oil candlestick; (5) statue of Diana in the Louvre, Paris; (6) reliquary, Cividale; (7) Greek statuary group, 'The Wrestlers', Florence; (8) jeweled arm and hand of metal, Catania; (9) sarcophagus of Empress Helena in Rome; (10) Roman chariot, Vatican, Rome; (11) crown of the 13th century, Namur cathedral, Belgium; (12) painting, 'The Dentist', by Gerard Dow, Dresden Art Gallery; (13) font at Parma; (14) painting, 'The Fortune Teller', Mieris, Dresden Art Gallery. The Italian eminence in art is easy to understand. Italy was heir of the Roman and Greek civilizations, and was also the birthplace of the Renaissance, so she has had the longest period in which to acquire treasures.

SOME OF ENGLAND'S RELICS OF BYGONE CENTURIES



Here are a few of the interesting objects in the British Museum, shown in the center picture (8). The ewer (1) showing Neptune and Amphitrite is 16th century Flemish work, while the portion of the Parthenon frieze (2) is among the most highly prized exhibits. The ivory horn (3) and the metal-work ewer from Mesopotamia (4) are of the 10th and 13th centuries, while the Roman helmet (5) and cooking utensil (6) are much older. But oldest of all are the Egyptian and Assyrian exhibits—statues of an Egyptian official and his wife (7), a winged god (9), the head of Ptolemy Auletes (10), the coffin of the priestess Ta-Ahti (11), and the Assyrian winged bull (12). The Portland vase (13), the most famous vase in the world, is from the time of St. Paul.

of a history book. We can go for a walk through history very near to Cromwell and Drake and Mary Queen of Scots, for we can read letters they wrote with their own hands; and at Oxford we can see a chair made from a piece of the ship in which Sir Francis Drake sailed around the world. We can see the things that Socrates and Plato saw; we can touch a thing St. Paul looked on; we can read the actual letter written by Anne Boleyn as her heart was beating high with the thought of marrying the Bluebeard King who murdered her.

The wealth of the museums of Europe is so immense that no man knows it, no gold can buy it. Treasure piled on treasure meets our gaze; wonder on wonder, tragedy on tragedy all the emotions that come into life from the cradle to the grave stir in us as we walk through these great galleries. Gems that glitter like the sun; things so beautiful that they seem to belong to a world of dreams; marvelous products of the patience of Nature and the immense labor of men's hands; ghastly sights from which we turn away and shudder; memories of immortal deeds; the touch of Shakespeare and Michelangelo; a little thing King Alfred owned, something Cromwell wrote, and an actual part of the body of Napoleon; fragments of history from every age and every land; types of life from every clime; Nature in all her seasons and in all her glory and through all her generations; the books that men have written, the pictures they have painted, the statues they have carved—it is all here.

And it is all here for you and me, treasure untold that belongs to the world. It has come to us from the Past, to which we owe our priceless heritage; it belongs to this generation of the world to hold in trust and to be handed on to that far-off Future which all good men believe will be greater and greater yet.

—REFERENCE-OUTLINE *for Organized Study of* EUROPE—

JUDGED by its size alone, Europe is a minor division of the earth's surface. Indeed, it is little more than a broken and irregular peninsula projecting westward from the vast land mass of Asia, and it is treated as a separate continent only because of its racial and historical individuality. Between Europe and Asia there is no sharp natural division as there is between Asia and Africa or North and South America. Many geographers, in fact, treat the two together under the name of Eurasia. Of the seven so-called continents, Australia alone is smaller than Europe. Yet, in the history of modern civilization and in the broadest geographical sense, Europe has played by far the most important part of all the continents. It has given its "point of view" to the world. When we speak of the discovery of a country, we mean its discovery by Europeans. The New World was "new" only from the European standpoint, not from that of the Aztecs or Incas or Iroquois. Americans still speak of eastern Asia as the "Orient" and the "Far East," although by the closest route from America, these lands lie to the West or Occident. That is because North and South America are the heirs of Europe, in race, language, customs, and ideas. The same is true of Australia, Africa, and the islands of the Pacific. Only the ancient civilizations of Asia have been able to withstand the dominating influences which spread from the shores of the Mediterranean and the eastern Atlantic. Why did Europe prevail over so much of the world in this extraordinary manner? An adequate answer to that question would involve countless subtle forces and influences which it is perhaps impossible to analyze fully, but it is certain that geography would play an important part in the solution of the problem. This outline deals with the more important geographical factors in the supremacy of Europe and with the historical movements of modern times which have vitally affected the continent as a whole or a number of the nations within it.

I. POSITION AND AREA:

A. Position: Europe is situated in the center of the land masses of the globe, about equally distant from the mid-points of all the four larger continents. This gives Europe an enormous commercial and political advantage.

B. Area: E-315, E-322, P-201 picture.

II. PHYSIOGRAPHY:

A. Geologic Influences:
   a. Northern Europe Largely Covered by Glaciers of the Ice Age: I-2, G-95.
   b. The Sinking of the Land: E-319, E-318 map.
      1. Great Britain Once Part of Mainland E-319.
      2. North Sea Once Dry Land N-170.
      3. Fiords of Norway Created by Sinking of Seacoast N-171–2, F-198, F-199 picture.
      4. Italy and Spain Once Connected by Land with Africa S-140, S-225.

B. Mountains and Highlands: E-318 map.
   a. Central and Southern Mountain Groups: Alps A-155; Apennines A-226; Dinaric Alps E-318; Transylvanian Alps R-178; Carpathian Mountains C-86; Balkan Mountains and Pindus Mountains B-17.
   b. Central Highlands: E-320. French Highlands F-178; Jura Mountains J-229; Vosges Mountains V-335; Black Forest B-153; Bavarian Highlands B-64–5; Thuringian Hills and Harz Mountains G-65–6, H-238; Bohemian Mountains B-167.
   c. Southwestern Mountains and Highlands: Pyrenees P-372; Sierra Nevada and Other Ranges and Plateaus Forming Part of the Iberian, or Spanish, Peninsula S-225, S-226 map.
   d. Northwest Highlands: In Brittany F-178; in British Isles E-268, W-2, I-124, S-44; Kjölen Mountains of Scandinavia N-171, S-336; Manselka Mountains of Finland F-44.
   e. Mountains of the Extreme East and Southeast: Urals U-260; Caucasus C-115.

C. Lowlands:
   a. Great Central Lowland: E-318–9. English Plain E-268; Paris Basin F-178; Lowlands of Belgium and Holland B-88, N-66; North German Plain G-65–6; Plains of Denmark and Southern Sweden D-50, S-336; Great Plains of Russia R-179–80.

D. Coast Line: E-316, E-326–7 map.
   a. Effect of Natural Harbors: H-214.
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E. Seas and Chief Rivers Flowing into Them:
   a. Mediterranean and Its Arms, the Adriatic and Aegean Seas: M-109, A-22, A-25. Rhine R-100; Po P-268.
   b. Atlantic Ocean: A-358. Guadalquivir, Guadiana, Tagus, and Douro S-225; Garonne F-178; Loire L-181.

c. North Sea and English Channel: N-170. Seine S-75; Thames T-74; Meuse M-131; Rhine R-93; Elbe E-213.
d. Baltic Sea: B-32. Oder G-65; Vistula V-309.
e. White Sea with Dvina River, Arctic Ocean with Pechora River: E-316, R-179.
f. Black Sea: B-154. Danube D-13; Dnieper, Don, Dniester E-316.
g. Caspian Sea: C-91. Volga River V-334.

F. Chief Islands: Iceland I-5; Great Britain G-144; Ireland I-124; Danish Islands D-50; Balearic Isles B-17; Corsica C-372; Sardinia S-28; Sicily S-139; Crete C-394.

III. CLIMATE: E-316.

A. Ocean Affects Climate: C-270a.
a. Russia's Continental Climate: R-180.
b. Gulf Stream Warms Western Europe: G-185.
c. Scandinavia and Southern Italy Present Two Extremes: N-172, I-155.
d. Effect of Warm West Winds and of South Winds: E-316, A-378.

B. Rainfall: E-322, R-47 map, E-318 map.

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A. Distribution of Land Products: E-322.
a. Grains: E-318, R-180, O-202, G-66, 67. Wheat E-318, W-83, 84, A-381, F-174; Corn E-318, R-175; Rye R-202, B-86; Oats O-191.
b. Sugar-Beet Belt: B-86, F-174, G-66, H-360, R-180.
c. Chief Grape Lands: H-360, P-313, S-227, F-174.
d. Potato Districts: G-66, N-176, I-124, F-174.
e. Olive Lands: E-315, P-313, S-228 picture.
f. Flax Lands: F-106, R-180, I-124, B-86, F-174.

B. Grazing Lands: R-180, I-124, F-175.

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B. Primitive Stock of Present Races: R-10, M-168, M-48, C-124, G-154, G-156, T-121, E-322.

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D. Diversity of Types, Customs, and Languages: E-320.

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Note: For the general history of Europe from early times through the period of the Reformation see the Reference-Outlines for Ancient History, Middle Ages, Renaissance and Reformation; and for the detailed history of a particular country, *see* the Reference-Outline for that country.

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E. Partition of Poland: P-276, M-63, K-40.

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IV. FRENCH REVOLUTION AND NAPOLEON: E-324, F-200, N-5–10. (*See also* Reference-Outline for France.)

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d. Central Powers Force Peace upon Rumania: R-174.
e. Russia Signs Treaty of Brest-Litovsk: R-189–90.

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EVAPORATION. A liquid exposed to the air gradually becomes a vapor or gas. The change is called *evaporation.* Common examples are clothes drying on a wash line and water vanishing from wet pavements after a rain. Some liquids, like alcohol, ammonia, and gasoline, evaporate more rapidly than water; others, like glycerin and mercury, more slowly. Many solids also undergo a kind of evaporation called *sublimation.*

To understand evaporation we must recall that the molecules of which every substance is made up are governed by two forces: *cohesion,* which tends to draw them together, and the *heat motion* of the individual molecules, which tends to make them fly apart (*see* Heat). When cohesion dominates, the substance is a solid. When heat motion is strong enough to overcome cohesion entirely, the substance is a gas (*see* Gas). When the two forces are in fairly even balance, we have a liquid.

At the surface of a liquid, molecules that happen to be moving outward more rapidly than their neighbors are likely to fly into space beyond the range of the force of cohesion. This escape of molecules is evaporation. It helps to explain many common facts.

Effects of Temperature and Pressure

Warming hastens evaporation, since the warmer the liquid, the more molecules will have speed enough to escape. The remaining liquid cools, since the escape of the fastest molecules reduces the average speed of those left behind.

In a closed container evaporation quickly stops because when the quantity of molecules in the vapor reaches a certain point, the number that strike the surface of the liquid and are recaptured equals the number escaping from the liquid. When this takes place, we say that the vapor has reached its *saturation point.*

A vacuum hastens evaporation, since the fewer molecules there are above the surface the smaller the chance that an escaping molecule will strike one of them and bounce back into the liquid; also, of course, the fewer will return by the chance of their own motion. Conversely, pressure which crowds together the molecules in the space above the liquid decreases evaporation. If the pressure is great enough it will force molecules back into the liquid, causing what is called *condensation.*

At any given temperature, the pressure at which equal numbers of molecules are leaving and re-entering the liquid is called the *vapor pressure* or *vapor tension.* This varies for different liquids because the force of the cohesion of their molecules is different. Liquids of feeble cohesion evaporate rapidly and thus have high vapor pressures.

What Is Relative Humidity?

The evaporation of water is a fundamental factor in nature (*see* Water; Rainfall; Dew). It takes about five times as much water vapor to saturate the air at a temperature of 100°F. as it does at 50°F. What is called the *relative humidity* is the ratio between the actual amount of water vapor present in the air and the amount the air would contain at the existing temperature if it were saturated. A temperature of from 68° F. to 70° F., with a relative humidity of from 50 to 60 per cent, is said to be ideal for health and comfort (*see* Heating and Ventilation).

EVEREST, MOUNT. No one has yet climbed to the top of the earth—the summit of Mount Everest, the king of the Himalayas. In recent years, expedition after expedition of expert climbers, equipped with the most modern devices, has attempted the ascent. Only a few men have struggled up its glaciers and sheer cliffs to within 1,000 feet or so from its summit, and several men have perished in the effort. Aviators, however, have flown over the mighty peak.

Seen from the Tibet side, Everest towers aloft in solitary majesty; but on the Indian side it is almost hidden by other high peaks in front of it. Yet the loftiest mountain in Europe is little more than half

as high as Everest, which towers 29,141 feet above sea level. It was named for Sir George Everest, who fixed its position and altitude. (*See* Himalaya Mountains.)

EVERGLADES. A vast tract of land and water which formerly occupied an area of 5,000 to 8,000 square miles in southernmost Florida, extending southward for 110 miles from Lake Okeechobee and averaging 45 miles in width. A considerable part of it has recently been reclaimed by drainage. Settlers are finding a hidden store of treasure in the bountiful crops of oranges, bananas, pineapples, and other fruits, and vegetables which they can grow on these lands. (*See* Florida.)

EVERGREEN. A tree or plant which retains its foliage throughout the year, such as the pine, fir, hemlock, laurel, etc. Evergreens are in contrast with deciduous plants, which shed their leaves periodically and are leafless during part of the year. The term evergreen is often taken to mean any tree with cones and needles—in other words a conifer—as opposed to a broad-leaved tree; but not all conifers are evergreens; for example, tamarack and other larches are clothed with needles and cones but shed their foliage in the fall. On the other hand, certain broad-leaved tropical or semi-tropical trees such as the laurel are evergreen, and do not lose their foliage in winter. (*See* Tree.)

HOW SCIENCE *Explains the Varied* FORMS *of* LIFE

The Age-old Process of Development which is called Evolution and the Theories Advanced to Account for its Method of Operation

FROM the day that Darwin brought the Evolution theory prominently before the world's attention, it has been a storm center. Many have believed, and many still believe, that it conflicts with religion, though its advocates insist that the Christian and evolutionary views of the universe are perfectly harmonious. It is certain, however, that no one scientific doctrine has had a more far-reaching effect. Therefore all intelligent people, whether they accept it or not, should have a clear understanding of what it is.

EVOLUTION. Native curiosity and interest in the phenomena of nature are fundamental qualities of the human mind. So we may be sure that long before the times of recorded history—perhaps many thousands of years before the discovery of writing to preserve men's thoughts—men began to ask themselves the whence and why of the living things about them. In those dim times of the remote past, much progress was made in taming for man's use both animals and plants, some for man's utility and some for his pleasure as companions or ornaments. These things about the homes of early men became much changed from the wild animals and plants that man knew, and we may be sure that the active minds of our remote ancestors wondered if Dame Nature had not also performed many experiments in changing the plants and animals under her charge.

The earliest recorded attempts to explain the changes of living things into other living things were those of the ancient Greeks six or seven centuries before Christ. Aristotle, the great master in the study of life in the 4th century B.C., had a clear idea that the higher forms of life had come from the lower. But such views were crippled, as viewed from our modern standpoint, by the general belief of those times that even higher forms (such as frogs) might arise spontaneously from non-living matter.

There have been many popular misunderstandings of evolution. One is that Charles Darwin was the "father of evolution." While we properly think of him as the great modern exponent and advocate of the doctrine, there had been a number of very able believers in evolution before the publication of Darwin's 'Origin of Species' in 1859—Lamarck in France (1744–1829) being the most notable of these. Another mistake is that Darwinism and evolution in general are the same, which is far from true. For, as we shall see later, while the doctrine of evolution has permeated all modern science, there are several theories of how evolution has taken place, and Darwinism is only one explanation. The whole matter of evolution is extremely complex, and it is very natural that many things should have been changed since Darwin's time, and that his explanations should be less accepted now than 50 years ago.

Again, it has frequently been supposed by those unfamiliar with the subject that evolution deals chiefly with "the descent of men from monkeys." While the evolution doctrine includes the development of man, this is but part of the grand general process which accounts for the development of all living things from the simplest forms of life. Furthermore, no evolutionist makes the absurd claim that the monkey is man's ancestor. The commonly accepted scientific opinion is merely that man is more nearly allied in physical structure to the ape than to the other animals.

Still another common misconception is that, if the theory were true, we should observe evolution taking place as an everyday occurrence. Man has worked wonders in changing wild animals and plants into his domestic forms of many varieties; but this has taken thousands of years, and evolution in general has taken many millions of years. The acceptance of evolution has been general for only 50 years or less, and while some changes have been observed in that time, they have not been very extensive. These 50 years are as but a second compared with the time life has existed.

The term "evolution" is frequently used rather loosely, as meaning the same as "organic evolution." But, properly speaking, the evolutionary hypothesis applies to the whole material universe, including the development of worlds as well as of living things. But the evolution of worlds is slow, taking perhaps hundreds of millions of years for our solar system to develop to its present state through the stages which science believes it can trace. (*See* Planets; Sun and Solar System.) Eventually the earth was formed, but for ages of time it was a very hot ball—so hot that all of the water now found in the seas was driven off from the earth in the form of a vast blanket of vapor around the earth hundreds of miles high. Finally the earth became cool enough and adapted to the presence of simple forms of life. Of the ultimate origin of life, the theory of organic evolution gives no account. It merely undertakes to show how the more complex forms of life we find about us on the earth today have developed from early primitive forms. (*See* Earth.)

How long has life been on the earth? Nobody knows very exactly. There have been several ways of estimating it, and some authorities think 50,000,000 years; some as much as 100,000,000 or more. But all scientists think it has been an "infinitely long" time, beyond the grasp of the human mind.

You will wish to know why scientists have accepted the doctrine of organic evolution as an explanation of the development of the existing forms of life. There is room here to cite only a very few of the vast number of illustrations from the mass of evidence that science has gathered.

What the Fossils Teach Us

Paleontology—the science of the fossils found in the rocks of the earth—gives us two types of evidence (*see* Fossils). First, that the early rocks contain fossils of the lower forms of life in great variety and abundance, but none of the higher. There were no backboned animals (vertebrates) in the world at that time. They came millions of years later, first only the primitive fishes. Later, through succeeding millions of years, amphibia (frogs and their kin) came; and then in succession early reptiles and the early birds and mammals. The early mammals gave rise to the many forms of hairy animals we know now, through perhaps 5,000,000 or 10,000,000 years. All along the line of evolution science shows that many forms of life have come into the world and vanished. This is especially striking in the case of reptiles. Through millions of years they were evolving. More than 20 orders of them were present at one time, "lords of the earth" during the millions of years called the "Age of Reptiles." (*See* Animals, Prehistoric.) Then, with the evolution of mammals, the reptiles grew fewer, till now there remain but four of the orders of reptiles.

The study of fossils also shows, in a few cases, the links in the chain of development. This is clear in the case of the horse—in which each foot retains only the middle finger or toe, with its nail greatly enlarged to form the hoof. We begin with horselike animals the size of foxes, which had all five fingers and toes on the feet. From these science traces a dozen stages, changing more and more through several millions of years, till the modern horse is developed. Has science traced the history of many forms, as clearly as it has that of the horse? No. Consider for a moment the formation of fossils. Of course, the simplest forms of life did not leave fossils, for they had no hard parts to fossilize. Again, even among animals with hard parts, it is the rare individual that has a chance to form a fossil—the vast majority are eaten, or otherwise disappear. And of the ones saved as fossils, man has found but a small proportion, for he can explore but a few specks, as it were, of the earth's crust. The horse, however, is sufficient to illustrate the evolutionary process.

The Evidence from Comparative Anatomy

The study of the comparative anatomy of animals also supplies much evidence for evolution. Just two or three citations, from the thousands that might be given. From low fishes to the highest animals, all vertebrates show the same *plan* of the brain, with nerves from the brain supplying the same parts of the head in all. Again, take the limbs of mammals or hairy animals. They are all built on the same plan. The bat's wing, for instance, has the same chief bones as the arm and hand of man. Yet how different in outward appearance! And so, case after case might be cited from the animal and plant kingdoms.

From embryology, or the development of animals and plants from egg cells, much evidence could be given (*see* Embryology). The principles are the same for all of the common forms of life—for an insect as for a mammal. The following type of evidence is especially striking: the highest forms of life tend to pass through the same stages in developing from the egg as they have in their evolution from the lower forms of life. The human embryo, for instance, when very small, has holes along the sides of the throat, like those of a fish. But they are perfectly useless and disappear long before birth.

The Whale's Lost Teeth

Evolutionists hold that such embryonic parallels, as well as the persistence of certain rudimentary organs, are explainable only on the supposition that the animals with the rudiments were evolved from more primitive animals that had the same organs in a useful condition. These two among many: Mammals in general have the same two sets of teeth as has man. The whalebone whale has two sets of teeth—only both sets are developed and *lost* before the little whale is born, and are never used at all! Again, the "vermiform appendix" in man's digestive tract is a rudiment, worse than useless; but it is the remnant of an organ that is useful in many other mammals. There are many such rudiments in man's body, perhaps a hundred of them inherited from the past, where they once were useful.

The study of the physiology of different animals also shows many striking similarities. Take the higher animals, for instance. They all do about the same things—nourish themselves, breathe, reproduce their kind, use the same general kinds of foods, form the same kinds of wastes, and many other things. The most striking illustrations of these similarities are shown among the common higher animals, where scientists have made many discoveries of very great importance in medicine and surgery. We have all heard of "vitamins"—mysterious materials of several kinds which are equally necessary to the health of man and other higher forms of animal life. Most of our knowledge of these substances has been learned first from studies on other higher animals, and later applied to man himself.

Domestic animals and plants show how man, by artificial selection or breeding, has very profoundly changed—or "evolved"—many of our common forms of life. Among chickens, for instance, the variety is so great that, if the different kinds were found in nature, they would easily be classed as different kinds of animals; for instance, the great "brahmas," weighing ten pounds or more, and the tiny "bantams," weighing but a pound. Yet all are derived from the same wild fowl of India. Again, if we were to come upon various kinds of cabbage, kale, cauliflower, Brussels sprouts, and Swedish turnips in nature, we would easily say they were altogether different kinds of plants. Yet man has derived them all from the same wild plant. (*See* Cabbage.) These two citations are very striking, but a great many others from domestic varieties might be given. Horses, cattle, dogs, sheep, various kinds of flowers, will occur to all.

The explanation as to *how* evolution of living things has taken place is the more difficult matter. For, while biologists are all agreed that evolution has taken place, they are far from agreeing as to the processes involved. We may perhaps best begin with Darwin's explanation, and then trace briefly the changes in scientific opinion since his time.

The "Survival of the Fittest"

There are a few great corner-stones of Darwinism. First, we have to consider the *materials* with which evolution has had to work. These are "variations" or the differences between individuals of a species. It is familiar to all that no two individuals are ever exactly alike. We notice the differences most clearly among people, mostly because we examine people more critically than we do other animals. But the same principle holds for any kind of animal or plant. Take wild rabbits, for example. They differ in size, color, and other characters. Some are better adapted for living in their surroundings, some not so well. Now, more young animals are born than can grow and reproduce their kind. In many species of animals and plants, thousands—even millions—come into the world from two parents. A toad, for instance, lays 20,000 eggs each year. But as soon as laid the losses begin. Some of the eggs perish or are destroyed; later, some of the tadpoles are killed and eaten by other animals; later still the little toads perish, till eventually only two, on an average, are left to take the place of the two parents. That is where "natural selection" comes in to cull out the less good, and to preserve the ones best fitted for the toad's surroundings. That is, there will result the "survival of the fittest." And so, generation after generation, the same thing will take place, with the result that the species is gradually better and better fitted for its place and conditions of life.

The most difficult part of the explanation is to see how an improved kind or species of animals will break up into two or more species. For, if one species makes two or more, with more and more lapse of time, greater and greater variety will result. It was in this way that Darwin supposed the whole living world was evolved, with the passing of millions of years. Several explanations have been offered, but they are rather too difficult to give here.

One of the great fighting grounds of evolution has been as to the nature of variations or differences among animals and plants of any species (whether small or great), and their causes. According to Darwinism, the effective differences are usually small, and are caused largely fortuitously (without known causes); in smaller measure they are caused by the transmission from parent to offspring of the modifications of the parent during its lifetime.

It will be interesting now to examine briefly two or three more modern views. The "Lamarckians" (who bring Lamarck's chief views up to date) believe that the differences among the individuals of any kind of plant or animal arise because the parent passes on the acquisitions of its lifetime to its offspring. As applied to man, an athlete would have children stronger physically than his fellows; an educated man, children with better intellect, etc. The children in each case would be better by nature. And so for a thousand things that one may imagine. But the followers of August Weismann (1834–1914) believe that the developments of the parent will not show in the nature of the offspring at birth. It seems the followers of Weismann have the better argument, and that the child will not inherit the *changes* that have come into the life of the parent. For instance, the feet of Chinese women are of normal size if let grow, though Chinese women have bound their feet for thousands of years. Many similar cases might be cited, showing that the changes are not passed from parent to child.

Still another view is that nature has taken advantage of the "sports" or "mutations"—that is specimens remarkably different from their fellows—that from time to time are born or spring up in any species of animal or plant. Such a mutation is seen in a person with two joints in the fingers instead of the usual three; or with six fingers and toes, instead of the usual five. Many of these mutations have been

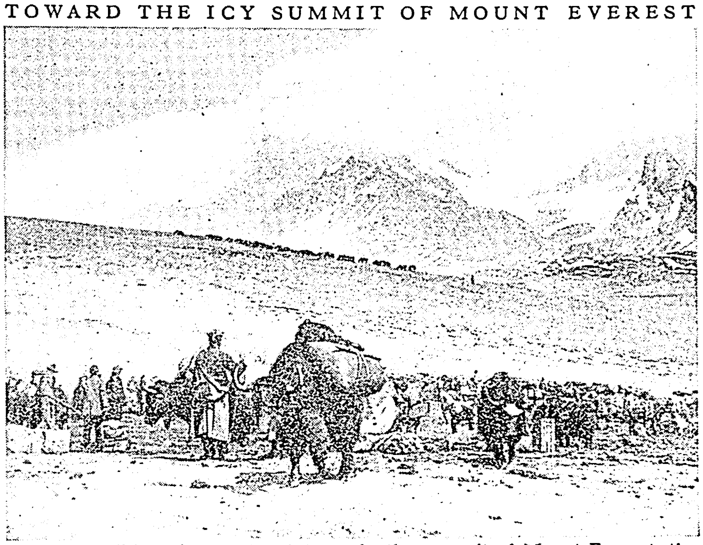
observed in both animals and plants, and it may be that they become the chief materials for the origin of new species; and, with the lapse of time, of more and more variety among animals and plants. There are other theories currently held as to the causes of organic evolution, but the ones here given show some of the points in dispute. It must be repeated, however, that while there are differences of opinion as to the *method* of evolution, the *doctrine* of evolution is believed by scientists more firmly than ever before.

DISTANCE *and* MYSTERY STILL LURE *the* EXPLORER

EXPLORATION. In the school geographies of less than 50 years ago the maps showed many blank spaces marked "unexplored." These blank areas included nearly all of Africa and central Asia, much of the interior of South America and Canada, as well as parts of Australia, New Zealand, New Guinea, Borneo, Sumatra, and other large islands.

Africa was called the "Dark Continent"—a land of unknown peoples, savage beasts, deadly fevers, and far-reaching jungles. South America was pictured as a white man's grave, a continent of dense forests swarming with wild beasts and head-hunting Indians. Australia and New Zealand were sparsely inhabited, and seemed to be at the "very ends of the earth." Tibet was the forbidden land wherein no white man was permitted. Alaska and nearly all of northern and central Canada were a trackless wilderness known only to Indians, and a few fur trappers, traders, and Hudson's Bay Company representatives. As for the Arctic and Antarctic regions, most people jeered at the idea of anyone ever reaching the poles, even after Lieut. A. W. Greely attained "the farthest north" of 83° 24′ in 1882.

TOWARD THE ICY SUMMIT OF MOUNT EVEREST



Many expeditions have set out to scale the summit of Mount Everest, the world's highest point. Here we see the expedition of 1924, commanded first by Brig. Gen. C. G. Bruce and later by Lieut.-Col. E. F. Norton of the British army, crossing the icy Tibetan plains with their baggage carried by yaks.

Today, however, one may drive an automobile or fly in an airplane the whole distance from Cape Town to Cairo, and men and women fearlessly set out on hunting trips to the heart of the African jungles. Great steamships make regular trips up the Amazon, and tourists travel from Chile to Argentina by airplane or railway over the Andes. Tibet, with its yaks, its monasteries, and its grotesquely garbed lamas, is brought to us in motion pictures; and both the North and South poles have been not only discovered but mapped and photographed.

Today we enjoy food that comes from places that were unexplored 30 years ago or less. We wear clothing made from the wool of sheep raised in Patagonia, Tierra del Fuego, or New Zealand. We drink coffee and cocoa grown in the heart of Africa and South America. Our furs may have been trapped on Arctic islands, the existence of which was undreamed of a few years ago. When we stop at a roadside filling station, we purchase gasoline made, perhaps, from oil brought from the wilds of South America. Thus, exploration vitally affects our everyday life.

This varied contribution of faraway places has come about because the past few decades have seen greater advances in scientific exploration than any similar period of time. Adventurous men, and some women, have risked their lives and their health in wild, savage, or desolate lands. They have penetrated dense jungles, fought dangerous beasts, met savages and cannibals, crossed great deserts, climbed lofty mountains, navigated uncharted seas, and voyaged on unknown rivers. They have endured these hardships, sometimes amid blinding snow and ice or under equatorial sun, in order to add to our knowledge of the lands and waters, resources, and peoples of the earth.

Exploring for Raw Materials

Just as the rapid exploration of America, following its discovery, was largely the result of the desire for gold and a richer commerce on the part of European nations, so the achievements of present-day explorations have often been the result of the amazing advances made in science, commerce, and industry. The ever-increasing use of automobiles, airplanes, and other motor-driven machinery compelled the great oil companies to search for new sources of supply throughout the world. As a result, many of the most important recent geographical explorations were made by engineers and prospectors seeking oil. They have explored and charted for the first time vast areas in Africa, Asia, Mexico, Central and South America, and

the East Indies. Other important explorations and surveys have been carried out by men in search of gold, silver, copper, tin, and other ores, and by representatives of business enterprises seeking to establish new avenues of trade.

The Department of Agriculture of the United States maintains a large force of experienced and daring men whose lives are devoted to exploring the most remote and least known portions of the world in a constant search for new plants, fruits, seeds, flowers, and vegetables to enrich our food supply and to add to our comfort. Hardier varieties of common plants are sought. Our supply of new and beautiful woods for interior furnishings and cabinetwork has been increased by men who have spent years in equatorial forests exploring hitherto unknown districts.

SAVING WATER FOR "THE GREAT THIRST"

Bushwomen of the Kalahari Desert region in Africa fill shells of ostrich eggs with water and hide them to provide for the dry period. These little-known people were visited by the Vernay-Long expedition in 1930.

Many expeditions are encouraged and supported by universities and by scientific organizations, such as the National Geographic Society, the Smithsonian Institution, the American Geographical Society, the Carnegie Institution, the Royal Geographical Society of Great Britain, and museums. Zoölogical gardens and other agencies constantly are sending out expeditions into every quarter of the earth, and while these men are studying the birds, beasts, reptiles, and insects of unknown districts, they are securing also geographical and commercial data.

The combined explorations of the ethnologists, the archeologists, and the fossil-hunters, or paleontologists, probably exceed those of all other explorers. To study primitive races, ethnologists must explore the most remote and unknown districts. In order to find the remains of ancient peoples, archeologists spend months, often years, hundreds of miles from civilization; and paleontologists explore deserts and mountains to collect the petrified skeletons of prehistoric monsters. As these men are scientists, trained to observe and to record every detail of their surroundings, they give us maps, photographs, sketches, and field notes, which help to fill in the ever-decreasing uncharted areas on our maps. (*See* Archeology.)

Occasionally an industrial development or an unexpected need has added to our geographical knowledge. When the sheep raisers of the Falkland Islands, the Argentine, and southern Chile required new pasturage for their rapidly-increasing flocks, Tierra del Fuego was thoroughly explored and mapped. Had it not been for the World War and the suddenly increased demand for metals, rubber, and many other articles, parts of Africa, South America, Asia, and the East Indies might still remain virtually unknown. On the other hand, many of the world's richest mines were discovered by men in search of wild animals, primitive races, strange plants, ancient ruins, or geographical knowledge. Others who have brought back supposedly worthless curios, souvenirs, or specimens from far-away lands have added immeasurably to our store of drugs, medicines, and plants. Even art and design have been influenced by the discoveries of explorers.

The automobile, the motor boat, the airplane, the motion-picture camera, and the radio have greatly aided recent explorations. Airplanes have roared over both the North and the South poles. Col. Charles A. Lindbergh, Dr. J. Alden Mason, and others have located and mapped important ancient ruins of the Maya in Central America. In Peru, Bolivia, and elsewhere, the airplane has proved indispensable in surveying and mapping the Andes region, and in locating and photographing Inca and pre-Inca ruins. In New Guinea, seaplanes following the courses of the rivers helped explorers to accomplish more in a few weeks than could otherwise have been done in years. The frozen wastes of northern Canada and Alaska have been brought into direct connection with civilization by means of airplanes.

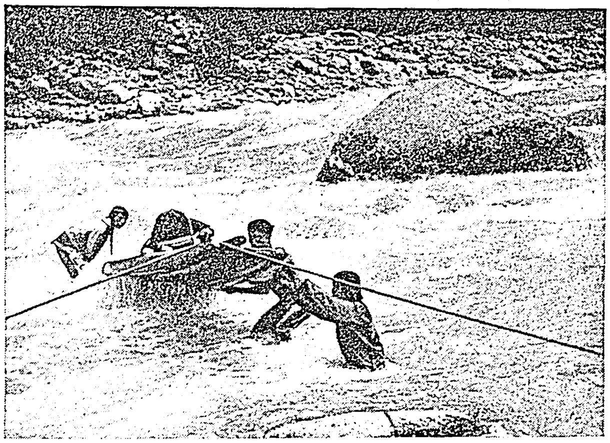
With the aid of motor boats, explorers have penetrated hitherto unexplored swamps and jungles bordering on tropical streams. Automobiles and motor trucks made possible the American Museum of Natural History expeditions into the Gobi Desert of Mongolia. With motor vehicles, capable of covering 100 miles a day, the work of ten years could be done in a single season. Although these expeditions, conducted by Roy Chapman Andrews with a staff of scientists, 40 porters, over 100 camels, and a fleet of automobiles and trucks, were primarily in search of fossils and traces of ancient man, yet other scientific data were also secured. To most persons, the dinosaur eggs obtained by these expeditions are regarded as their most remarkable discovery, but perhaps the most significant find was a prehistoric monster somewhat resembling a giant rhinoceros. This immense beast, the *Baluchitherium*, stood 13 feet high and was over 24 feet in length, and could feed upon the leaves of trees 22 feet above the ground.

Through the radio, explorers in the most remote regions have kept in touch with the outside world. Admiral Richard Byrd at the South Pole, the Hobbs expedition at Mount Evans in Greenland, the Rice expeditions on the upper Amazon, all talked nightly

with friends in the United States; and in their camps thousands of miles distant they heard the music, the news items, and the baseball and prize-fight returns broadcast from various United States radio stations.

These modern inventions contributed not only to the comfort but also to the safety of explorers. Formerly there was scarcely an expedition that did not lose some members; whereas today the loss of life even in the most dangerous places is very small, although an expedition may be away for a year or even more.

HARDSHIPS ARE THE EXPLORER'S LOT



Fast streams, dense jungles, icy cold or tropic heat are all one to the explorer in quest of the unknown. A balsa raft of the George Dyott expedition is here shown wrecked in an Andean river but sturdy natives and strong ropes salvaged the load.

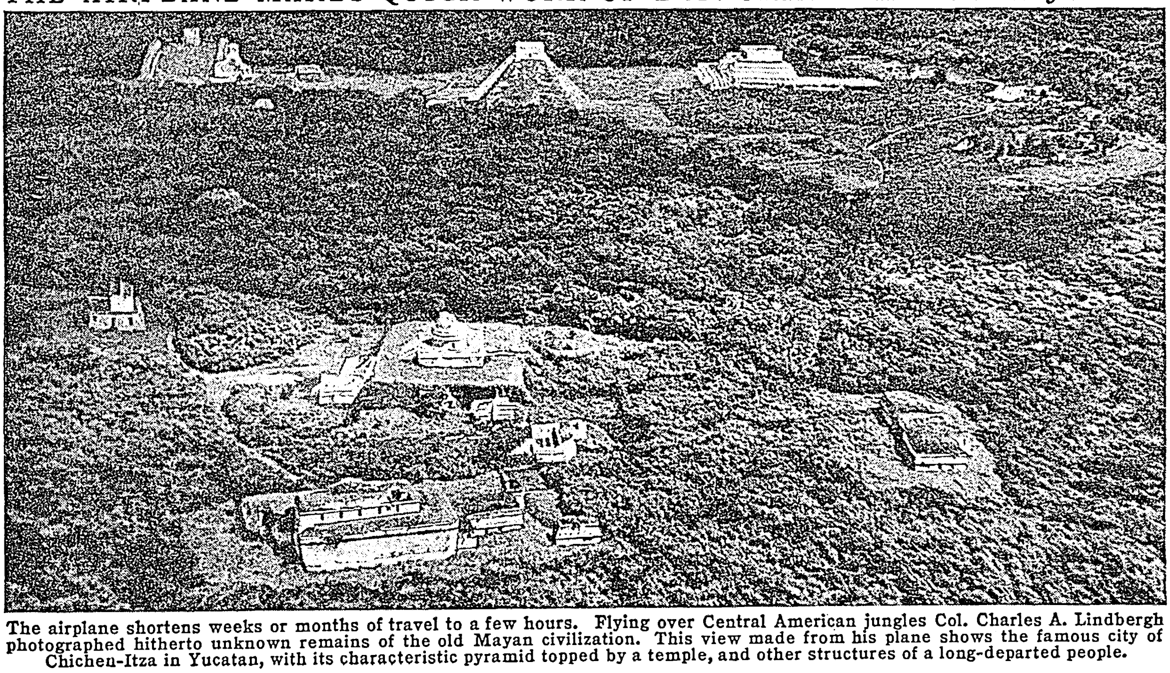
Exploring the Ocean

Even the bottom of the sea has yielded its secrets to the indomitable and resourceful explorers of the present century. J. E. Williamson in his underseas chamber has secured motion pictures of the ocean floor and its fascinating and strange coral forests, its fishes, and other forms of life. Dr. William Beebe in a steel ball has descended to depths of thousands of feet and through glass windows has observed the weird, luminescent inhabitants of these extreme depths.

However, long before either the Williamson apparatus or the Beebe sphere was dreamed of, scientists and oceanographers had been patiently, laboriously exploring the beds of the oceans. Prof. Alexander Agassiz, Prof. Spencer F. Baird, Prof. A. E. Verrill, the Prince of Monaco, and others devoted many years to this branch of exploration. As a result innumerable varieties of valuable sea foods have been discovered. The tilefish or scrod, now one of our most important food fishes, was found through the explorations of the United States Fish Commission off the New England coast. Deep-sea scallops, now marketed in great quantities, were unknown until discovered by Prof. A. E. Verrill while exploring the bed of the sea. The habits of lobsters, fish, oysters, and other marine creatures of great economic value were all learned by deep-sea studies. The explorations made by the Prince of Monaco added immeasurably to our knowledge of ocean currents and the haunts and habits of whales, and the surveys of the depths of the ocean made by the non-magnetic ship, the *Carnegie*, were of great importance to mariners and scientists.

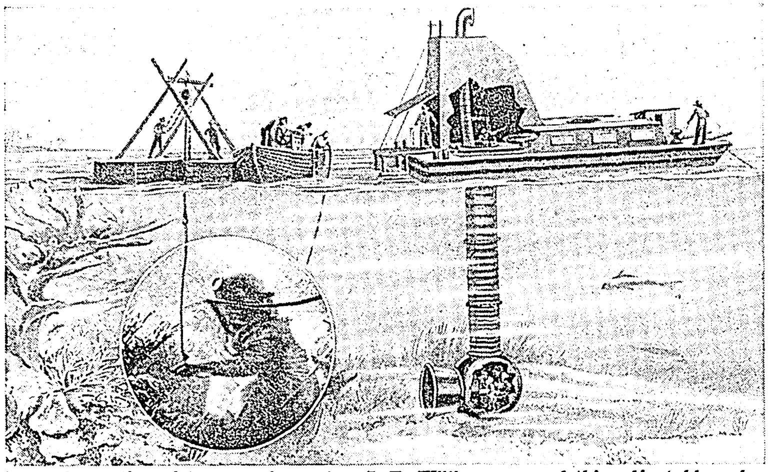
Perhaps the most interesting results of exploration are not the discoveries of new mountain ranges, rivers, and cataracts, but the finding of strange peoples, rare

THE AIRPLANE MAKES QUICK WORK OF EXPLORING THE DENSE JUNGLE



The airplane shortens weeks or months of travel to a few hours. Flying over Central American jungles Col. Charles A. Lindbergh photographed hitherto unknown remains of the old Mayan civilization. This view made from his plane shows the famous city of Chichen-Itza in Yucatan, with its characteristic pyramid topped by a temple, and other structures of a long-departed people.

MAKING MOTION PICTURES ON THE OCEAN BED



To make motion pictures under water, J. E. Williamson used this adjustable submarine tube. Williamson, in diver's equipment, is shown in the circle gathering coral specimens in Bahaman waters while a photographer in the circular room at the end of the tube takes his picture.

The polar expeditions (*see* Polar Exploration) of Peary, Amundsen, Scott, Shackleton, Byrd, Wilkins, and others, and the finding of the bodies, the journals, and the photographs of the lost Andrée polar expedition after 33 years, have not only gained widespread interest but also given us geographical and meteorological facts of great value. This, likewise, is true of the discovery of the remains of a great forgotten empire, made by Col. Peter Kozloff in northern Mongolia in 1923; Charles W. Furlong's trip across Patagonia and Chile; the discovery of the Valley of Ten Thousand Smokes in Alaska; Prince William of Sweden's explorations in Uganda; and the British explorations of the Nile basin.

Important discoveries were made as a result of E. S. Grogan's journey afoot from Cape Town to the Mediterranean in 1900; the explorations of Hassanein Bey and Mrs. Rosita Forbes through the African deserts in 1920; the Roosevelt and Rondon River of Doubt expedition in 1913–14; the journeys of Miss Gertrude Bell, perhaps the first woman to deserve the true title of explorer, through unknown Arabia; and the explorations in Arabia made by Maj. R. E. Cheesman in 1923–24, when he discovered the mysterious oasis of Jabrin in the Great South Desert, and found ruins of unknown ancient cities. The Conover-Everard explorations gave us information about Lake Tanganyika in east-central Africa, one of the longest fresh-water lakes in the world, which today is regularly traversed by passenger steamers. A. Hyatt Verrill in 1924 discovered the remains of a lost civilization in Panama, with its Temple of One Thousand Idols, its marvelous pottery and sculptures, all of which, like Pompeii, were covered thousands of years ago, by a volcanic eruption.

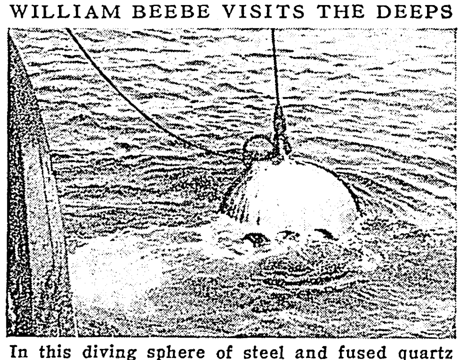
Even more thrilling, however, than any of these was the exploration in 1917 of the great Arabian Desert by H. St. John B. Philby, the second white man to cross the arid waste from the Persian Gulf to the Red Sea through a country filled with warlike, fanatical Arabs. He surveyed over 300 miles to the south, mapped the deserts and oases, followed the pilgrim route to Mecca, and finally visited and was the first to describe the city of Riyadh (El Riad), an oasis of 15,000 inhabitants. Yet Philby was not on an exploring expedition, but on a political mission!

Probably the most adventurous, thrilling, and tragic chapters in recent explorations are those

animals, and remains of forms of life now extinct. Many persons scoff at "digging up old bones," as they say, yet explorations for fossils have notably contributed to our knowledge. The discovery of the Rhodesian skull in South Africa and of the Peking skull in China, for example, has thrown new light on early man. Sir Harry Johnston found the okapi, a rare relative of the giraffe, in central Africa. Pigmies, regarded as fabulous when reported about 1860 by Paul du Chaillu, a French scientist, have been tracked to their hiding places in the African forests; and another tribe of pigmies in New Guinea has been discovered. Stone Age Bushmen were found by an expedition to the Kalahari Desert of South Africa. Bearded Indians of Bolivia were reported by A. Hyatt Verrill.

In addition to these are the discoveries of the giant lizards or "dragons," first found by an aviator forced to land on the island of Komodo in the Dutch East Indies; the Ovis poli, or Marco Polo sheep, and the Asiatic ibex, a rare creature resembling a mountain goat found by the James Simpson-Roosevelt expedition; the giant panda, last of a distinct family of mammals resembling bears, obtained by the William V. Kelley-Roosevelt Asiatic expedition for the Field Museum; the remains of fossil bison, ground-sloths, and other prehistoric beasts killed by men with flint weapons in the western part of the United States; the bones of mastodons associated with those of human beings, found in Ecuador; the gorgeously attired mummies of the ancient Parakans, found in southern Peru; and the finding of the mummy of a royal Inca.

WILLIAM BEEBE VISITS THE DEEPS



In this diving sphere of steel and fused quartz William Beebe of the New York Zoölogical Society's Oceanographic expedition descended more than half a mile, observing ocean life and telephoning his observations to the ship.

regarding the attempts to reach the "roof of the world"—the summit of Mount Everest, 29,002 feet above the sea. Since the government of Tibet first gave permission in 1921, successive parties have reached heights of 22,000, 27,300 and 28,200 feet.

This article has dealt only with explorations of the present century. The story of how geographical knowledge was extended in times past is told in other articles. (*See* America; Geography; Middle Ages; Northmen; etc.; and names of great explorers.)

MODERN TITANS *with which Man* MOVES MOUNTAINS

On Oct. 10, 1885, a group of men sat in a wooden cabin overlooking Hell Gate, the narrow passage in the East River which connects Long Island Sound with New York harbor. Half-way across stretched Flood Rock, making a dangerous barrier to navigation. One of the men pressed an electric key. The ground trembled; there was a rolling muffled roar. The vast bulk of Flood Rock rose slightly, then fell and vanished. Within a minute, 25 feet of churning muddy water was flowing over the spot where the rock had stood. Imagine a solid mass of stone as big as a city block and 15 stories high blasted away in less than 60 seconds! What is the mighty power that did this work? Nothing but "chained wind"—the expansive power of gases suddenly set free, about which this article tells you.

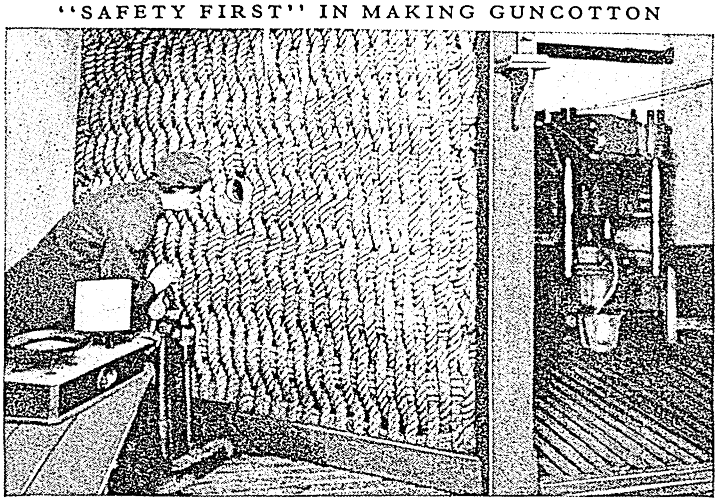
EXPLOSIVES. The gases that explosives release when they "let go" are the most powerful force under man's control. The pressure developed by ordinary gunpowder, when fired in a space which it completely fills, is more than 6,000 times that of the atmosphere. When we realize that the "high explosives," such as guncotton, dynamite, nitroglycerin, mercury fulminate, and scores of others, are from four to six times as powerful as gunpowder, we see what an amazing force has come into men's hands. Mercury fulminate is the most violent of all the explosives in practical use, for it develops under proper conditions a pressure of 200 tons per square inch. The strongest cannon-barrel ever made would fly into pieces under such a pressure.

What causes the sudden release of gases which we call an explosion? To understand this we must first realize that many solids and liquids are composed in whole or in part of substances which ordinarily are gases. Water, for instance, consists of the gases hydrogen and oxygen; mercury fulminate is composed of mercury, carbon, and the gases nitrogen and oxygen. Water is not explosive, while mercury fulminate is. This is because the hydrogen and oxygen which form the water are very "friendly" to each other—they are linked by a strong chemical attraction and cannot be easily separated; while mercury fulminate is an unstable compound and its components do not get along well together—they are constantly looking for an excuse to split up. If struck or rubbed or pressed, they fly apart very suddenly.

Instead of the solid mercury fulminate, therefore, we have two gases—nitrogen and carbon monoxide—and mercury vapor, which occupy vastly more space now they are separated than they did when combined. It is the sudden and violent moving of the gases and vapors into this new space that constitutes the explosion. These gases are like "unchained winds."

Any substance which breaks up easily and suddenly, producing a large volume of gas, is an explosive. There are some, like nitrogen iodide, which are so sensitive they will explode at the tread of a fly or the touch of a feather. There are others which require a hot flame to set them off.

''SAFETY FIRST'' IN MAKING GUNCOTTON



In the corner to the right is a press used in making the high explosive guncotton. It must be tended like any other piece of machinery, but since guncotton has a way of exploding "out of turn" every now and then, the job of running the press is not a popular one. The difficulty is solved in part by the rope screen with the peep hole. Here the operator takes shelter with his controls, and in case of accident, has a chance for his life.

Broadly speaking, explosions may be of two kinds—extremely *rapid burning*, as in the case of gunpowder, and *detonating*, as in the case of mercury fulminate or nitroglycerin. In the first case, the flame starts in one spot and spreads quickly over the entire mass. In the case of detonation, however, a shock or jar causes all parts of the substance to "let go" at virtually the same time. Guncotton illustrates both kinds of explosion. If set off by a flame it will usually burn rapidly, creating a large quantity of gas, but without exhibiting extreme violence. If, however, a cap or primer or

fuse made of some detonating substance like mercury fulminate be set off in contact with the guncotton, the latter will in turn be detonated. The ordinary dynamite stick can be set on fire with a match without great danger, but will explode with shattering force in response to a fulminate cap.

Since the first form of explosion is merely extremely rapid burning, it follows that any inflammable substance can become more or less explosive if it can be made to burn rapidly enough. Since all ordinary fire or combustion is caused by the combination of the burning substance with the gas oxygen (*see* Oxygen), it follows also that the more oxygen is present the faster will be the blaze. For example, coal gas, hydrogen, and the vapors of gasoline, alcohol, ether, turpentine, etc., are themselves non-explosive, but they become explosive if they are mixed in the right proportions with the oxygen of the air. The loud back-firing so frequent in a gas stove is caused when too large a supply of air is admitted to the gas pipe through the vent. This principle of explosive mixture of gases and vapors with air is used in the automobile and all gas engines (*see* Gas Engine).

Many serious accidents have arisen from so-called "dust explosions." When the air is filled with finely powdered charcoal, coal, flour, soap, wood, sugar, starch, or any other combustible substance, a flame or a spark may start a blaze which will travel through the dust cloud so rapidly that it creates a violent and destructive blast.

Explosives which are to be used for practical purposes, however, cannot depend upon the air for their supply of oxygen. It must be provided in concentrated form so as to be available even when the explosive is excluded from contact with the air. In black gunpowder, which is a mixture of charcoal, saltpeter, and sulphur, the saltpeter (potassium nitrate) provides oxygen (*see* Gunpowder). But in most explosives, each molecule of the compound contains all the oxygen needed. Liquid oxygen itself can be used as an explosive. A porous cartridge of wood pulp, powdered aluminum, or other combustible material is soaked in liquid oxygen, and fired with a detonator before the oxygen evaporates. Instantaneous combustion produces terrific explosive force. A few detonating explosives, such as nitrogen iodide, have no oxygen; they act when the compound splits and the parts expand because of heat generated by the break.

Why Most Explosives Have Nitrogen

Some compound of nitrogen is used in most explosives because this element is extremely "unsocial" and ready to break away from the others in the compounds (*see* Nitrogen). It is usually introduced through the action of nitric acid, as a rule mixed with sulphuric acid. With cotton, nitric acid forms guncotton and nitrocellulose; with glycerin, it forms nitroglycerin; with ammonia, ammonium nitrate. With phenol (carbolic acid) it produces picric acid, the base of such explosives as lyddite and melinite. Nitration of toluene obtained from coal tar or by catalysis of gasoline yields trinitrotoluol or trinitrotoluene (TNT), one of the commonest military high explosives. Dynamite is nitroglycerin mixed with some absorbent substance to reduce danger of explosion from shock (*see* Dynamite and Nitroglycerin). Amatol is a mixture of TNT and ammonium nitrate; ammonal contains powdered aluminum, TNT, charcoal, and ammonium nitrate.

Getting "Smooth" Explosives in Firearms

High explosives are used as bursting charges in shells and bombs, but they are too violent to use as propelling charges in firearms. For this purpose slower-burning smokeless powders have been developed. Most of them are nitrocellulose formed into grains, flakes, or cylinders. Certain kinds, such as cordite and ballistite, contain some nitroglycerin.

These powders, while less violent than the high explosives, are much more powerful than black powder and have the additional military advantage of producing little or no smoke. At the beginning of the explosion they are comparatively slow burning and start the bullet or shot smoothly on its way, gradually increasing the pressure and speed as the projectile nears the muzzle, and reaching the maximum power at the moment of discharge. The speed with which these powders burn is also controlled by the shape and size of the grains—large smooth grains burning more slowly than small rough ones, and giving therefore a more gradual expansion of the explosive gases.

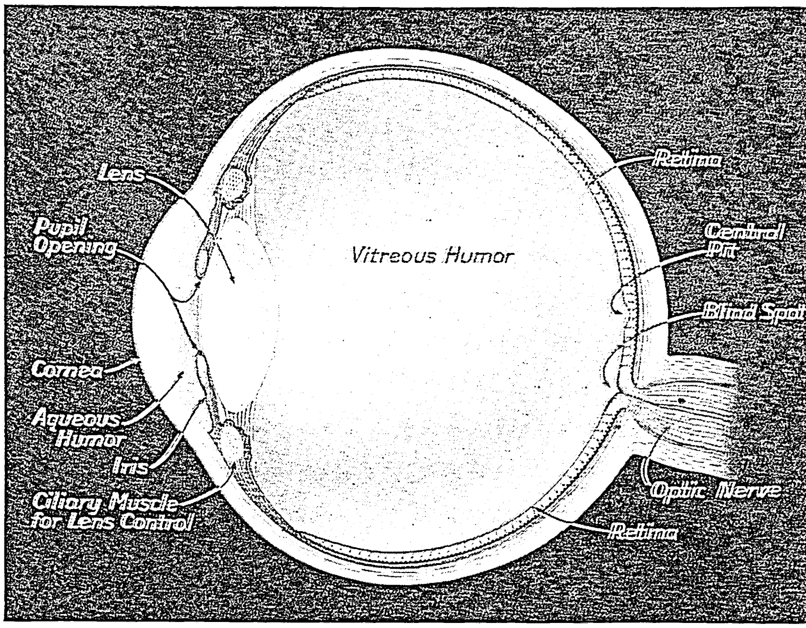
This smooth and gradual increase in velocity is of the utmost importance in firing shells filled with high explosives, for a sudden and violent shock might well explode such shells before they left the gun. As it is, the high explosive shells are equipped with detonators, which set off the bursting charge when the shell strikes its mark, or with time fuses which cause the explosion a certain time after the shell has left the muzzle of the gun.

Besides their destructive use in warfare and hunting, explosives are of immense value in scores of peaceful pursuits—in mining, quarrying, and engineering enterprises, in making fireworks, signal lights, and rockets. They are used to project lifelines to ships in distress off storm-beaten shores or to the roofs of burning buildings; to cast oil upon rough seas or to break up ice-jams. When pile drivers are not available, their work can be done by exploding dynamite on an iron plate placed on top of the piles. Floating derelicts which endanger ships at sea are destroyed with explosives, and great fires are halted by blowing up buildings in their path. Farmers use them for breaking up bowlders, blowing out stumps, felling trees, and loosening the soil for deep cultivation.

Most nations and states, however, find it necessary to regulate carefully the sale of explosives, for in the hands of lawless persons they are powerful instruments of crime, such as blowing open safes and vaults by "cracksmen," or making bombs and "infernal machines" by political fanatics and others. (For the history of explosives *see* Gunpowder.)

WHAT HAPPENS *When We* "SEE" THINGS

EYE. When we look at an object, the light reflected from it passes through the lens of the eye, and an image is formed on the retina. The action is the same as when a camera lens projects an image on photographic film. In the eye, however, the image does not stop at the retina. Like a television picture, it is transmitted through the optic nerve to the brain, where it is recorded and where we recognize the object the image represents. Let us look closer at the remarkable machinery that makes all this possible.



In this diagram you are looking down *from above* into the right eye. Notice that the blind spot where the optic nerve leaves the eyeball is off center toward the inside of the head.

Cornea and Iris

The first thing that the light encounters on reaching the eye is the transparent *cornea*. This is like a very thick watch crystal on the front of the eyeball. It begins at the edge of the white and covers all the dark part of the eye. The space immediately behind it is filled with a clear liquid called the *aqueous humor*. The cornea and the liquid taken together form an outer lens of meniscus or crescent shape, which gathers light rays over a wide angle and bends or *refracts* them toward the center of the eye. At the back of the space that contains the aqueous humor lies the *iris*, a muscular tissue with a round hole in the middle of it. This opening is the *pupil*, which expands or contracts to control the amount of light that passes into the interior of the eye. When we speak of the color of a person's eyes, we mean the color of the iris.

The Self-Adjusting Lens

Through the pupil, the light passes into the main lens. This is biconvex like an ordinary magnifying glass. But unlike a glass lens, it is elastic and can change its focus.

The change is controlled by an ingenious mechanism. All around the edge of the lens is attached a membrane that contains scores of threadlike fibers. Like the spokes of a bicycle wheel, these fibers radiate from the lens to a muscle which is shaped like a tire. This is called the muscle of accommodation or the *ciliary muscle*.

When this muscle is at rest it is widest open, and thus it keeps a constant slight tension on the fibers attached to the lens, which tends to flatten the lens's surfaces. In this condition, the lens of a normal eye brings to a sharp focus on the retina the images of objects that lie 20 feet or more away.

To bring nearer objects into focus, the ciliary muscle contracts and the circle it forms becomes smaller. Thus the pull on the edge of the lens decreases. Through its own elasticity, the lens draws together, and its sides curve out more. This, of course, shortens its focal length (*see* Lens), and the images of the nearer objects become sharp and clear on the retina. When the ciliary muscle releases all tension on the lens, the normal eye of a child can bring into focus objects as close as 2½ inches. With age, the elasticity of the lens decreases, and a 50-year-old eye that can focus sharply on an object ten inches away is considered normal.

The space between the lens and the retina is filled with a clear jelly-like substance called the *vitreous humor*. The rays of light that form the image pass through this without change.

The Retina and Its Tiny Detectors

The real act of seeing begins at the retina. It is a transparent membrane, and the image formed by the lens penetrates to its innermost structure. There it encounters a layer made up of about a million tiny nerve cells. These are of two kinds, *rods* and *cones*, so called because of their shapes. They may be called the detectors of the eye, and they divide up their work.

The cones are very keen. They detect the lines, the points, and the colors of the image. The sharp details of the printing you see on this page, for example, are detected by the cones. When you look up from the page and gaze through the window, it is the cones that detect the green in the leaves of a tree and the blue of the sky. There are special cones for each of the primary colors of light—blue-violet, green, and red; and they coöperate in detecting the intermediate colors (*see* Color). It is the cones that make it pos-

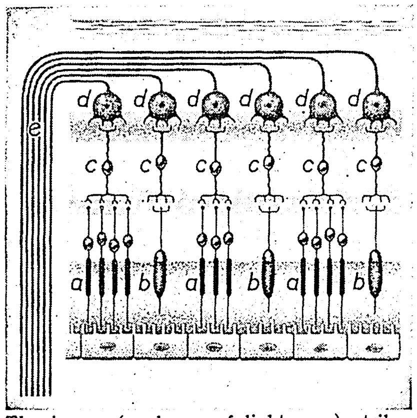
sible for us to do work that requires skill, discrimination, and accurate measurements.

Less acute than the cones are the rods. These detect no clear lines or points, and none of the colors, but only the tones—the lights and darks—of the image. In this they are exceedingly sensitive. They can distinguish the outlines or silhouettes of objects in almost total darkness where the cones can detect nothing at all. When we walk down a strange unlit street or through a dark unfamiliar room, it is the rods that enable us to find our way and avoid collisions.

The rods can detect an image in the dark because they contain a special pigment called *visual purple*. In bright light this substance turns yellow, and the rods lose their extreme sensitiveness, so we can stand the glare of the sun. But in the dark, the visual purple starts to form again, until the sensitiveness of the eye to light is multiplied about 2,000 times.

This explains what we mean by "getting used to the dark" when we walk into a motion-picture theater. It may take as long as 45 minutes for the visual purple to reach its maximum.

HOW THE RETINA WORKS



The image (made up of light rays) strikes down from the top, passing other elements in the retina, until it reaches the deeply buried rods (*a*) and cones (*b*). Here the light waves are transformed into electrical impulses which pass upward through bulbs, fibers, and across gaps to the bipolar cells (*c*). These in turn convey the impulses to the ganglion cells (*d*), which transmit them directly to the fibers of the optic nerve (*e*). Notice that there is a separate fiber for each rod and cone circuit.

The inability of some eyes to form sufficient visual purple results in so-called *night-blindness*. This is usually caused by a lack of vitamin A in the diet (*see* Vitamins).

The Geography of the Retina

Let us see how the rods and cones are arranged around the retina. The very center of the retina, a small depression called the central pit (*fovea centralis*) contains only cones. It is the area of most acute detection. This area is often called the "daylight eye" because it functions only in bright light. Around the central pit lies an area in which rods and cones are intermingled. Finally, around the outer part of the retina is an area that contains only rods. This is often called the "night eye." It is this area that enables us so readily to detect shapes and movements far on each side of the straight line of vision or, as we say, "out of the corner of the eye." In darkness, indeed, we may become aware of a faint shape off to one side or of a small dim light like a star, only to have it disappear from our vision when we turn to look at it directly. There is enough light to impress the rods, but not enough for the cones. Scientists say that this explains why some people think they see ghosts at night.

The Optic Nerve and the Blind Spot

When we say that the rods and cones "detect" the image thrown upon the retina by the lens, we mean that they transform the light energy that strikes them (with its varying wave lengths and intensities) into corresponding electrical or nerve impulses. These impulses then travel to the brain through the *optic nerve*.

This nerve is made up of hundreds of thousands of fibers—one for each cone in the retina and one for each small group or cluster of rods. The fact that the nerve impulses from several rods are fed into a single nerve fiber explains why their "messages" are stronger but less distinct than those of the cones.

At the point where the optic nerve leaves the eye, there are no rods or cones and, therefore, no light detection. This is called the "blind spot." To prove its existence for yourself, make two black spots about the size of a pea and about 3½ inches apart on a sheet of white paper. Now cover the left eye and keep the *right eye* sharply fixed on the *left-hand spot*. At arm's length you will clearly notice from the side of your eye the presence of the right-hand spot. But as you draw the paper nearer your face, you will find a place where the *right-hand spot seems to disappear*. This takes place when the image of that spot reaches the blind area of the retina. For success in this experiment the left eye *must* be kept covered and the right eye *must* be kept on the left-hand spot.

Where Vision Takes Place

The part of the brain to which the optic nerve delivers its impulses is called the *visual center* (*see* Brain; Nerves). This is where we really "see" things in the sense of recognizing and understanding what our eyes look at. In other words, this is where *vision* is completed—where sensation turns into perception (*see* Sensation and Perception).

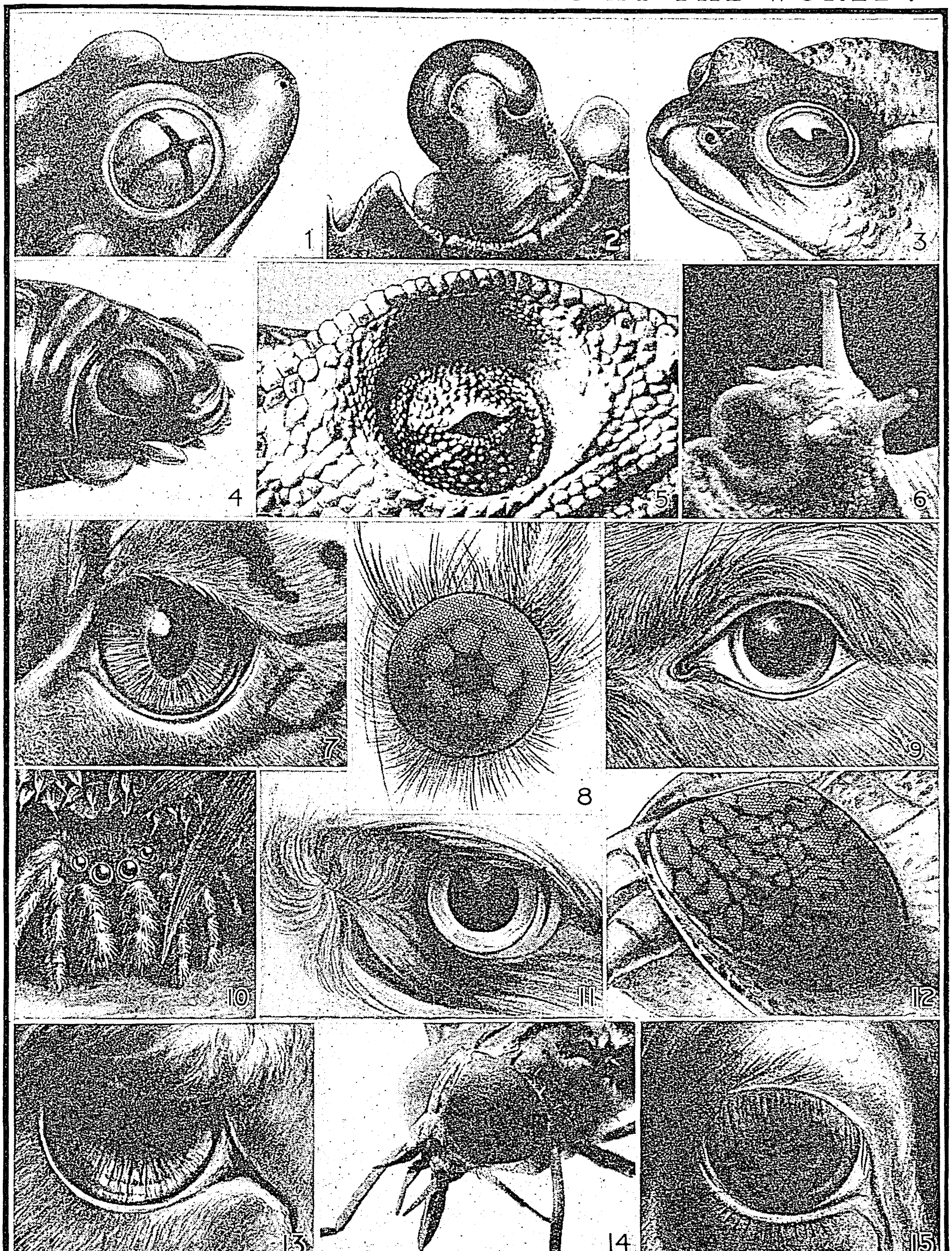
The brain must learn by experience to analyze correctly the messages it receives from the eyes. For instance, the lens system of the eye, like that of a camera, projects images that are upside down (*see* Lens). The brain has to learn that the impulses received from the *upper* part of the retina represent the *lower* part of the object sighted and vice versa.

In the brain also are located the centers that control all the eye's muscular movements, such as the opening and closing of the iris, the focusing of the main lens, and the movement of the eyeball. The movement of the eyeball is under voluntary control. The other adjustments of the eye are automatic reflexes (*see* Reflexes).

How the Two Eyes Work Together

Normally we use both eyes when we look at an object (*binocular vision*). Thus two images of the object are formed at the same time—one on the retina of each eye. Both images, of course, are sent to the brain, which has learned by experience to interpret them not as the images of two different objects, but as two views of the same object. Because the eyes are about 2½ inches apart from pupil to pupil, and there-

SEVERAL WAYS OF LOOKING AT THE WORLD!



(1) Eye of Solitary Frog; (2) "stalk eye" of Crab; (3) eye of the Toad; (4) Whirligig Beetle; (5) the Chameleon's eye; (6) eyes of the Snail on stalks; (7) Cat's eye; (8) Moth's eye; (9) eye of the Dog; (10) Spider eyes; (11) Eagle's eye; (12) Grasshopper's eye; (13) Sheep's eye; (14) eye of the Fly; (15) the Cow's eye. Nos. 4, 8, 12, and 14 are compound eyes.

fore are looking at the object from different angles, the two views are not exactly alike (*stereoscopic effect*). If the object is far away, the difference between the images is slight, but becomes very great for an object that is only a few inches from the eyes.

The brain makes good use of this fact. It learns to judge the distance of an object by the degree of difference between the images it receives from the two eyes. In the same way the brain perceives what is called *perspective*, that is, the differences in distance between two different objects or between two parts of the same object (*see* Perspective; Sensation and Perception; Stereoscope).

(There are other ways of judging distance for which two eyes are not required. If we know the actual size of an object, we learn to estimate its distance from the size of the image it makes on the retina. When we do not know the size of an object, we can estimate its distance by scanning the intervening objects. For example, we can estimate how far a yacht is from the shore by scanning the waves between the shore and the yacht.)

The eyes are turned up, down, and sideways by long muscles attached at one end to the top, bottom, and sides of the eyeball and, at the other end, to the bony walls of the eye socket. These muscles are regulated with the most delicate precision so that normally they turn both eyes toward the same object at exactly the same time.

Persistence of Vision

While the eyes are in motion we cannot see an object clearly. The image on the retina must come to rest, if only for a tiny fraction of a second. That is why, when we scan a broad landscape, our eyes move across it in a series of quick jerks, with brief stops between them. The same thing happens when we read a line of type (*see* Reading).

On the other hand, when the image has registered, the vision of it persists from 1/25 to 1/50 of a second. That is why our eyes are deceived, so to speak, by motion pictures. A movie consists of a rapid series of still pictures flashed on the screen, with about 1/60 of a second of complete darkness after each one. But persistence of vision fills in the dark moment. It also blends each picture so perfectly with the one that went before that we get the same impression that true motion produces.

How the Eyeball Is Protected

The eyeball is well protected. It lies within a bony socket of the skull, embedded in fat. The eyelids guard it in front. They blink an average of once every six seconds. This washes the eyes with the salty secretion from the tear glands (*lachrymal glands*), keeping them moist and free from dust. Each tear gland is about the size and shape of an almond, situated behind the upper eyelid at the outer corner of the eye. After passing over the eyeball, the liquid from the gland is drained into the nose through the *tear duct* at the inner corner of the eye. When we laugh heartily or cry, muscles in the upper eyelid squeeze the lachrymal gland, and tears come out faster than they can be drained away.

The eyelashes catch many flying particles that otherwise would enter the eye. As a further protection, the eyelids automatically close when any object moves suddenly close to the eye.

Defects of Vision

Some eyes are abnormally long from front to back, and the lens, even when stretched to its flattest, cannot bring *distant* objects to a focus on the retina. Nearsightedness or *myopia* is the result. This defect is corrected by wearing a concave (negative) spectacle lens, which, together with the convex (positive) eye lens, makes an optical system of longer focus.

When the distance between the front and the back of the eye is too short, the lens, even when relaxed to the utmost, cannot bring *near* objects to a focus. This is a form of farsightedness called *hypermetropia*. Another and more common form is *presbyopia* (old eye), common in older people, in which the lens loses some of its elasticity and no longer swells out to its roundest when the muscles of accommodation relax the tension upon it. Farsightedness is corrected by a convex (positive) spectacle lens, which combines with the eye lens to produce a shorter focus.

In many eyes the cornea is deformed so its surface is oval instead of truly spherical. As a result, the light rays are distorted at their very entrance into the eye (*astigmatism*). Depending upon the direction of the cornea's oval curvature, it tends to blur the horizontal, the perpendicular, or the oblique lines of the image projected upon the retina. To correct astigmatism, spectacle lenses must be given a nonspherical (cylindrical) curvature offsetting the abnormal curvature of the cornea, so the two together will act as a spherical surface. (*See also* Spectacles.)

When the two eyes fail to work together in harmony because of muscular defects (as with cross-eyes or wall-eyes) or because of extreme differences in their focusing power, the images formed on the two retinas may be so unlike that they cannot be blended in the brain. Thus a double image is perceived (*double vision*). Unless this defect is corrected by prismatic spectacle lenses or by other methods, the brain learns to disregard entirely the image formed by one of the eyes, and fixes its attention on the other. In time the neglected eye may lose some of its visual powers.

Which Is Your Favorite Eye?

In general, even in persons with normal two-eyed vision, the brain gives greater emphasis to the image formed by one of the eyes. The favored eye may be called the "sighting eye." It can be identified by sighting a distant object across the end of a pencil, held at arm's length, keeping both eyes open. Now, when the "sighting eye" is closed, the distant object will be seen to shift out of line with the pencil.

Color Blindness

Imperfections in the cones of the retina, due to inheritance and more rarely to disease, cause defective color vision, known as *color blindness* or *Daltonism*, from John Dalton, a famous chemist who described his own case. In total color blindness, which is very rare, everything appears in different shades of gray as in an ordinary photograph. In its most common form, color blindness is the inability to distinguish between reds and greens. Both appear to be a grayish yellow. Though true color blindness is seldom cured, minor defects of color vision are sometimes improved by concentrated doses of vitamin A (*see* Vitamins).

Hygiene of the Eye

Any injury or severe pain of the eye and any soreness or inflammation of the eyelids should receive the immediate care of an eye specialist. Dirty handkerchiefs and towels, fingers, and caustic liquids should be kept away from the eye. Many eyes are saved in factories by the rule that goggles must be worn by all who are exposed to intense heat and light, dust, flying particles, or spraying liquids. (For a discussion of proper reading habits and the importance of good lighting, *see* Hygiene. For a method of removing particles from the eye, *see* First Aid.)

THE EASY REFERENCE FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS
BEGINNING WITH

D-E

TO SAVE TIME

USE THIS INDEX

EDITOR'S NOTE ON NEXT PAGE TELLS WHY

SPECIAL LISTS AND TABLES

Numerous other lists and tables in the fields of geography, history, literature, science, mathematics, and other departments of knowledge will be found with their appropriate articles in the main text

EDITOR'S NOTE

Every user of Compton's Pictured Encyclopedia should form the habit of *first* turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

The arrangement of subheadings is alphabetical, except in major historical and biographical entries. In these the chronological order is followed.

The pictures illustrating a specific subject as a rule appear on the same pages as the text to which you are referred. But often illustrations placed elsewhere will prove of additional interest and value. These are indicated by the word *picture* followed by a page number.

A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read.

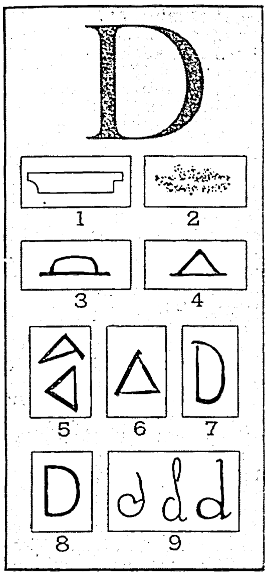
The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated only where usage is equally divided. For foreign names the native pronunciation is given except where the English pronunciation has become thoroughly established, as in "Paris," "Barcelona," "Seine."

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are given in round numbers, except for places in the United States and Canada, where the figures are those of the latest official census. Distances between points are map or air distances, not distances by railroad.

THE EASY REFERENCE FACT-INDEX

Reg. U. S. Pat. Off.



OUR LETTER D probably started in Egyptian writing as a picture of a door (1). To the Egyptians this picture meant 'door'. Shortly after 2000 B.C., a Semitic people called the Seirites adopted it as an alphabetic sign for the sound of 'd', because their word *daleth* for 'door' began with this sound.

The surviving Seiritic inscriptions have been so badly weathered that the sign is almost illegible (2); but the door appears clearly in the later Canaanite-Phoenician alphabet. Many of the city dwellers made the sign look like a house door, but slightly rounded (3); others imitated the wedge-shaped, or cuneiform, letters of Mesopotamia, and used a triangle in the sign (4). The triangle prevailed in later Canaanite writing (5). The name of the sign remained *daleth*.

When the Greeks learned how to write from the Phoenicians, they took over the triangular sign, but they straightened it up (6) and named it *delta*. An Italian colony of Greeks from Chalcis curved the letter slightly (7), somewhat as the city-dwelling Semites had; and this shape led to the Latin form (8). From Latin the capital letter came without change into English.

In handwriting, the triangle became a rounded form (9), which was easier to make. This form appears in manuscripts of the 1st century after Christ. Both our printed and handwritten small 'd' have high, vertical strokes at the right.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Dab-chick, or **pied-billed grebe,** popularly called **hell-diver** G-151, *pictures* G-151, B-127, *color plate* B-133
foot, *picture* B-129

Dablon (*däb-lôṅ'*), **Claude** (1618?–97), French Jesuit missionary; labored among Onondagas in New York (1655–58) and Crees in Canada (1661–69); later as superior of missions directed Allouez's explorations and appointed Marquette to accompany Joliet.

Dabney, Charles William (born 1855), American agriculturalist, economic geologist, and educator, born Hampden-Sidney, Va.; professor chemistry, University of North Carolina, and director North Carolina Agriculture Experiment Station; later held similar position in Tennessee; president University of Tennessee 1887–1904, of University of Cincinnati 1904–20.

Dabo, Leon (born 1868), American painter, born Detroit; influenced by Whistler and the Japanese, but original in his treatment; pictures of Hudson River and the sea show subtle contrasts of light and shade.

Daboia (*dȧ-boi'ȧ*), a viper V-303

Dabrowa Gornicza (*dôṅ-brō'vȧ gọr-nē'chȧ*), or **Dombrowa,** Poland, mining town 40 mi. n.e. of Cracow; pop. 37,000.

Dacca (*dăk'ȧ*), city of British India in e. Bengal on Buri-Ganga River; pop. 140,000; muslins, gold and silver ware, shell bracelets; university; ruins: *map* A-332c

Dace, also called **dare,** or **dart,** a fish included in the carp group; most beautiful member of the minnows, or Cyprinidae.

Dachshund (*däks'hṳnt*), a short-legged German hunting dog D-82, *pictures* D-81, 84

Dacia (*dā'shĭ-ȧ*), ancient country of central Europe; present Hungary, Transylvania, and Rumania; between Danube River and Carpathian Mountains: R-174

Da'cite, an igneous rock generally gray but brownish with exposure; name from Dacia, ancient Roman province: M-184

Dactyl (*dăk'tĭl*) (from Greek *daktylos,* finger, because of fancied resemblance to three joints of finger, one long, two short), poetic foot: P-269

Da'daism, an art movement which began as early as 1910 with Paul Klee; became widespread 1919–20; primary aims to abolish restraint and create sensation; design usually geometrical, often developed with objects, such as spools or wire, as well as with paint; Joan Miro, Francis Picabia, Marcel Duchamp among chief Dadaists (*dada* in French means "hobby-horse"); term also applied to a freakish literary movement that sprang up in Europe shortly after 1st World War.

Daddy-long-legs, or **harvestman,** a spider-like arachnid with small body and unusually long legs S-257

Daedalus (*dĕd'ȧ-lŭs*), in Greek mythology, the first man to fly D-1

Daf'fodil N-11
planting G-7

Daggers S-358, 359

Daghestan (*dȧ-gĕs-tän'*), an autonomous republic of Russian Soviet Federative Socialist Republic in the Caucasus on w. side of Caspian Sea; about 22,400 sq. mi.; pop. 930,000; before 1812 a province of Persia, later of Russia; cap. Makhach-Kala (pop. 87,000).

Dagnan-Bouveret (*dän-yäṅ' bọv-rĕ'*), **Pascal Adolphe Jean** (1852–1929), French painter, pupil of Gérôme, noted for pictures of peasants; an excellent colorist ('The Conscripts'; 'The Consecrated Bread').

Dagö. *See in Index* Hiiumaa

Dagobert (*dȧ-gō-bêr'*) **I** (reigned 622–638), king of the Franks, extended empire of Franks and improved their laws; 'Chanson du Roi Dagobert' ('Song of King Dagobert'), which satirizes Dagobert and his treasurer, St. Eloi, became popular as political song, being modified to suit different epochs.

Da'gon, a Semitic god, worshiped by the Philistines when they settled in Canaan; origin uncertain and little is known of the cult of the god: P-170

Daguerre (*dȧ-gêr'*), **Louis** (1789–1851), French painter and physicist; invented daguerreotype I-117
camera, *picture* I-114

Daguerreotype, an early photographic process, using silver-coated copper plates.

Dahl, Anders D. (1751–89), Swedish botanist and friend of Linné. The dahlia is named for him.

Dahlgren (*däl'grĕn*), **John Adolf** (1809–70), American admiral, born Philadelphia; blockaded Charleston during Civil War; inventor of smooth-bore Dahlgren gun.

Dahlia (*däl'yȧ*), garden flower D-1

Dahna (Little Nefud) Desert, Arabian desert, 30 mi. wide, 400 mi. long A-237, *map* A-242

Dahomey (*dȧ-hō'mĭ*), fertile colony of French West Africa, former Negro kingdom; about 43,243 sq. mi.; pop. 1,350,000; 70 mi. coast; cap. Porto Novo: *map* A-42a
army of women A-140

Daibutsu (*dī'bṳt-sọ*), the great Buddha of Japan J-200, *picture* J-202

Dail Eireann (*dôl âr'ĭn*), name formerly applied to Irish Republican Parliament, now to lower house (House of Representatives) of Eire legislature: I-131, 128

Daily News Building, Chicago C-193, *picture* C-190

Daimio (*dī'mē-ō*), early Japanese feudal baron J-191

Daimler (*dīm'lẽr*), **Gottlieb** (1834–1900), German inventor A-388

Dain'gerfield, Elliott (1859–1932), American figure and landscape painter, born Harpers Ferry, W. Va. ('Slumbering Fog', 'The Child of Mary'; mural paintings in Church of St. Mary the Virgin, New York City).

Dai Nippon, empire of Japan J-186

Dairen (*dī'rĕn'*), formerly **Dalny,** important city and free port in

Key—cāpe, ăt, fär, fȧst, what, fall; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, do; cūre, bŭt, rude, full, bûrn;

FACTS ABOUT DAMS OF THE WORLD HAVING THE LARGEST WATER CAPACITY

Name	Location	Use	Finished	Height in Feet	Length in Feet	Cubic Yards Material in Dam	Amount of Water Held (Billions of Gallons)
Boulder	Colorado R.	Flood control, power, irrigation	1935	726*	1,244	3,250,335	10,543
Fort Peck	Montana	Flood control, navigation, power	1941	250	21,578	109,000,000	6,325
Cauvery-Mettur	India	Irrigation, power	1934	176	5,300	2,018,518	5,978
Grand Coulee	Columbia R., Wash.	Flood control, irrigation, power	1941	550	4,300	10,500,000	3,101
Kentucky	Kentucky	Flood control, navigation	(†)	150	8,655	3,845,000	1,987
Denison	Oklahoma—Texas	Flood control, power	(†)	165	14,000	15,475,000	1,898
Shasta	California	Irrigation, flood control, power	(†)	560	3,100	6,000,000	1,464
Gatun	Canal Zone	Navigation	1912	115	8,324	22,958,089	1,437
Assuan	Nile, Egypt	Irrigation	1912, 1933	174	6,985	1,732,306	1,322
Marshall Ford	Texas	Flood control, power	(†)	270	2,623	3,581,000	1,016
Elephant Butte	New Mexico	Irrigation, power	1916	306	1,162	605,200	859
Norris	Tennessee	Flood control, power, navigation	1936	265	1,872	1,150,000	836
Bagnell	Missouri	Power	1931	148	2,543	551,000	749
Saluda	South Carolina	Power	1930	208	7,800	11,000,000	749
Pensacola	Oklahoma	Flood control, power	(†)	147	5,595	500,000	716
Hume	Australia	Irrigation	1934	200	5,300	4,433,000	651
Kingsley	Nebraska	Flood control, irrigation, power	(†)	162	10,200	26,000,000	651
American Falls	Idaho	Irrigation	1927	87	5,258	248,940	555
Sardis	Mississippi	Flood control	(†)	117	14,550	16,842,000	508
Santee	South Carolina	Power	1942	45	41,200	9,622,000	437
Roosevelt	Arizona	Irrigation	1911	280	1,080	342,970	420
Bartlett	Arizona	Irrigation	1939	287	750	165,000	391
Coolidge	Arizona	Irrigation, power	1928	249	932	204,000	391
Owyhee	Oregon	Irrigation	1932	417	833	537,000	364
Dnieper‡	U. S. S. R.	Power, navigation	1932	140	3,350	968,000	291
Cobble Mountain	Massachusetts	Water supply, power	1932	263	730	1,800,000	264

*Highest in the world.
†Under construction.
‡Destroyed by Russians before evacuating region in October, 1941.

Key—cāpe, ăt, fär, fȧst, what, fall; mē, yĕt, fērn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, do; cūre, bŭt, rude, full, bûrn;

father; later became distinguished through his work in physiology of plants and other botanical studies.

Darwin, George Howard (1845–1912), English geologist and astonomer, son of Charles Darwin
origin of the earth and the moon E-130, M-252

Darwin, Sir Horace (1851–1928), English scientist and inventor, son of Charles Darwin; designed instruments for recording earthquake shocks, for measuring growth of small plants.

Darwin, Leonard (born 1850), English economist, son of Charles Darwin; served in Royal Engineers 1871–90, winning rank of major; wrote on bimetallism and municipal trade.

Darwin, seaport, cap. of Northern Territory, Australia; pop. about 1500; air and naval base: *map* A-372*a*

Darwinism, the evolutionary theory of Charles Darwin D-15–16, E-340, 342
effect on: biology B-115; zoölogy Z-227

Das (*däs*), **Chitta Ranjan** (1870–1925), Indian nationalist leader and first mayor of Calcutta
in Swaraj movement I-40

Da'sent, Sir George Webbe (1817–96), English author; his translations of Scandinavian folk-lore have been especially appealing to children ('Gisli the Outlaw'): S-313*f*

Dash, mark of punctuation P-368

Dasheen (*dă-shēn'*), a broad-leaved plant of the arum family, a variety of Polynesian taro (*Colocasia esculenta*); cultivated chiefly for its edible bulbs which resemble the potato in food quality; introduced into U.S. from Puerto Rico and grown commercially in southern states.

Dashur, Egypt, place s. of Great Pyramids E-206

Dashwood, E. M. (Mrs. Arthur Paul). *See in Index* Delafield, E. M.

Dashwood, Elinor and **Marianne,** two sisters who represent 'Sense and Sensibility' in Jane Austen's novel of that name.

Daskam, Josephine Dodge. *See in Index* Bacon, Josephine Dodge Daskam

Dasyure (*dăs'i-ūr*), a marsupial mammal, genus *Dasyurus,* found in Australia; lives in trees, carnivorous; size of small domestic cat, snout pointed, fur short and spotted, tail long and bushy; habits like those of the weasel.

Date Line, International T-95, *maps* T-95, P-10*b–c*

Date palm D-18–19, P-37, *picture* P-38

Dates, fruit of date palm D-18, 19

Datura, a genus of annual or perennial plants, shrubs, and trees of the nightshade family, found in most parts of the world; includes jimson weed, or thorn-apple, and angel's trumpet. Horn-of-plenty (*D. metel*) has large flowers, 7 inches long, white within, violet outside, trumpet-shaped, fragrant, sometimes with several trumpets, one within another.

Daubigny (*dō-bēn-yē'*), **Charles François** (1817–78), French landscape painter and etcher of Barbizon school; first pictures were realistic landscapes; later work shows beginnings of Impressionism: P-22

Daudet (*dō-dĕ'*), **Alphonse** (1840–97), French novelist, likened, for humor and sentimental pathos, to Dickens; he wrote 'Tartarin de Tarascon', good-natured satire on the boastful, imaginative Provençal; 'Numa Roumestan', satire on Gambetta; 'La Belle Nivernaise', children's story.

Daudet, Léon (1867–1942), French literary critic, novelist, and polemical writer; son of Alphonse Daudet; a leader of Royalist party and one of founders of its organ *Action Française.* Most of his work reflects his vehement personality; his 'Souvenirs' depicts with gentle irony modern political and literary life.

Daugavpils, also **Dvinsk,** city in s.e. Latvia; pop. 45,000; railroad center; linen and flax; sawmills: *map* P-278

Daugherty, Harry M. (1860–1941), American lawyer; campaign manager for President Harding and U.S. attorney general in his administration: H-220

Daugherty, James Henry (born 1889), American illustrator and mural painter, born Asheville, N. C.; illustrated Irving's 'Knickerbocker's History of New York' and Sandburg's 'Abe Lincoln Grows Up', also children's books including 'Andy and the Lion', and 'Daniel Boone', awarded Newbery Medal 1939
illustration, *picture* L-117

Daughters of the American Revolution P-89
Mrs. Benjamin Harrison W-93

Daughters of the Confederacy, United, patriotic organization composed of female relatives and descendants of Confederate Civil War veterans; founded 1894 at Nashville, Tenn.

Daughters of the King, a religious organization of women and girls in the Episcopal church corresponding to the Brotherhood of St. Andrew; senior and junior departments; founded 1885 in New York City; chapters in England and Canada.

Daughters of the Revolution P-89

D'Aulnoy, or **Aunoy, Marie de la Motte, Comtesse** (1650–1705), French author of fairy tales in style of Perrault L-158, S-303*j*

Daumet (*dō-mĕ'*), **Pierre Jérôme Honoré** (1826–1911), French architect, born Paris; noted for restoring monuments of French architecture, Palais de Justice, Paris; Château de Chantilly.

Daumier (*dōm-yā'*), **Honoré** (1808–79), French caricaturist, painter, and sculptor; satirical power revealed in his caricatures; paintings, long unnoticed, now rank among most significant of his time
lithographs L-164

Dauphin (*dą'fin,* French *dō-făṅ'*), title of obscure origin; probably at first a proper name; borne first by Guigue IV (died 1142), dauphin of Viennois; the territory held by the dauphin became known as Dauphiné; after 1364 title given to eldest son of French king, Dauphiné having become crown land
Charles VII and Joan of Arc J-219–20
"Lost Dauphin," *picture* L-203

Dauphin, Manitoba, town 178 mi. n. of Winnipeg; pop. 4147; on Vermilion River; grain elevators, flour mills: *map* C-50*b*

Dauphiné (*dō-fē-nā'*) **Alps,** a range of the Alps, in Dauphiné, former province in s.e. France; greatest height 13,462 ft.: *map* F-179

Davao (*dä'vou*), Philippine Islands, city on Gulf of Davao, s.e. coast of Mindanao; pop. 96,000; cap. of Davao province; trade center for fertile region producing abaca and copra: *map* P-10*b*

Davenport, Charles B. (born 1866), zoölogist, born Stamford, Conn.; after 1904 director of the Carnegie Institution laboratory for experimental evolution at Cold Spring Harbor, N. Y.; made important contributions to the study of genetics.

Davenport, Edward Loomis (1816–77), American actor, born Boston; father of Fanny Davenport; best known for Shakespearean and Dickens characters (Brutus in 'Julius Caesar'; Bill Sikes in 'Oliver Twist').

Davenport, Fanny (1850–98), American actress, born London, England; star in wide variety of comic and tragic rôles under management of Augustin Daly; greatest success in 'Fedora', 'La Tosca', and 'Cleopatra'.

Davenport, Homer C. (1867–1912), American caricaturist, born Silverton, Ore.; remembered for his political cartoons; originated brutish giants to represent trusts and the dollar-marked suit of Mark Hanna.

Davenport, John (1597–1670), a Puritan divine, born in Coventry, England; left England after ecclesiastical disagreements; one of founders of New Haven, where he was minister for 30 years and also influential in civil matters.

Davenport, Thomas (1802–51), American inventor, born Williamstown, Orange County, Vt. S-307, I-117

Davenport, Iowa, city on Mississippi River opposite Rock Island, Ill.; pop. 66,039; shipping point for farm produce, coal; heavy machinery, locomotives, farm implements, flour, lumber; St. Ambrose College: *map* I-120
dam, *picture* I-119*b*

Davey, John (1846–1923), American tree surgeon, born England, called "father of tree surgery"; founded Davey Tree Expert Co.: T-137

David, Saint (544?–601?), patron saint of Wales, born probably in Cardiganshire; as primate of South Wales, moved seat of church government from Caerlon to Menevia; founded numerous churches
festival March 1 H-322

David, king of Israel (about 1000 B.C.) D-19
birthplace B-101
descended from Ruth R-202
statue by Michelangelo I-170, M-148
takes Damascus D-8

David I (1084–1153), king of Scotland 1123–53, son of Malcolm Canmore and Saint Margaret of England; called "maker of Scotland"; reformed courts, established many towns; promoted trade, shipping, and manufactures.

David II (1324–71), king of Scotland, crowned king 1331 at death of father, Robert Bruce; began to rule 1341; weak and inefficient.

David, Sir Edgeworth (1858–1934), Australian explorer; professor of geology, University of Sydney 1891–1924
with Shackleton P-283

David (*dä-vēd'*), **Félicien César** (1810–76), French composer, called "the musical orientalist"; wandered for years in East; wrote vivid, colorful pieces including symphonic ode, 'The Desert'; oratorio, 'Moses on

ü=French *u*, German *ü*; *ġ*em, *ḡ*o; *th*in, *th*en; *ṅ*=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); *ḳ*=German guttural *ch*

long; thus by silk of 10–12 deniers is meant yarn of which a piece 450 meters long will weigh between 10 and 12 deniers.

Den'iker, Joseph (1852–1918), French naturalist and anthropologist, born Astrakhan, Russia; author of 'Races of Man' and many other important ethnological and zoölogical works.

Denikin (*dyĕ-nē'kĭn*), **Anton** (born 1872), Russian general on general staff in early part of first World War; after revolution followed Kornilof, later becoming anti-Bolshevik Cossack commander operating between Caspian and Black seas 1919: W-174–5

Den'im, a heavy, cotton twilled fabric, usually colored; coarser weaves are used for overalls, children's play suits, etc.; finer, for drapery and upholstery. Name comes from French town of Nîmes ("serge de Nîmes").

Denis (*dŭ-nē'*), **Saint** (Latin **Dionysius**), apostle to the Gauls (250? A.D.), first bishop of Paris, martyr and a patron saint of France; legend says he ran for some distance carrying his head in his hand after he was beheaded for his faith by order of the Roman governor; festival October 9; abbey near Paris: P-75

Denis, Maurice (born 1879), French artist, chiefly noted for decorative murals which show influence of 15th-century Italian fresco painters; excels in religious art.

Denison, George Taylor (1839–1925), Canadian soldier and author, born Toronto; was an important figure in Canadian political life; became lieutenant colonel and was in active military service in 1866 during the Fenian raids, and in 1885 during the Riel Rebellion ('A History of Cavalry'; 'Soldiering in Canada'; 'The Struggle for Imperial Unity').

Denison, Tex., industrial town 65 mi. n. of Dallas in rich farming section; pop. 15,581; railroad shops, cotton and flour mills, mattress and overall factories: *map* T-56

Denison Dam, in Oklahoma and Texas, *table* D-357

Denison University, at Granville, Ohio; Baptist; founded 1831; liberal arts, music.

Denmark, one of the three Scandinavian kingdoms of n.w. Europe; 16,568 sq. mi.; pop. 3,700,000; cap. Copenhagen: D-50–4, S-36, *maps* D-53, E-326*c, d, f*, *Outline* D-54. A list of rulers of Denmark will be found on this page
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RULERS OF DENMARK SINCE THE UNION OF KALMAR

DENMARK, SWEDEN, AND NORWAY	
1397–1412	Margaret and Eric VII (Eric XIII of Sweden)
1412–1438	Eric VII (alone)
[1438–1440	Interregnum]
1440–1448	Christopher III
1448–1481	Christian I
1481–1513	John
1513–1523	Christian II (Sweden revolts and becomes independent 1523)
DENMARK AND NORWAY	
1523–1533	Frederick I
1533–1559	Christian III
1559–1588	Frederick II
1588–1648	Christian IV
1648–1670	Frederick III
1670–1699	Christian V
1699–1730	Frederick IV
1730–1746	Christian VI
1746–1766	Frederick V
1766–1784	Christian VII
1808–1839	Frederick VI (regent 1784–1808) (Norway annexed to Sweden, 1814)
DENMARK	
1839–1848	Christian VIII
1848–1863	Frederick VII
1863–1906	Christian IX
1906–1912	Frederick VIII
1912–	Christian X

- history D-53
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  - slave trade abolished S-161
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- ships: tonnage in 1939 S-129

Dennis, Clarence James (born 1876), Australian writer; founded *The Gadfly*, a weekly publication, Adelaide ('Backblock Ballads'; 'Rose of Spadgers'): A-376

Dennis, Hannah, Virginia heroine V-308

Dennis, John Stoughton (1820–85), Canadian surveyor, born near York, Upper Canada; surveyor of public lands in Canada; his decisions on land ownership in the Northwest did much to cause the first Riel rebellion.

Denominate numbers A-285

Denomina'tions, or sects, religious R-72

Denonville, Jacques-René de Brisay, Marquis de (died 1710), French soldier and governor of New France 1685–89; brought about a disastrous war with the Iroquois by treacherously seizing a band that had come on a peace mission.

Density, in physics P-189
- densest substance: on earth A-345; Sirius' companion star A-345
- earth E-132
- specific G-142–3
- water W-44–5

Dent, John Charles (1841–88), Canadian journalist and historian, born England ('The Canadian Portrait Gallery'; 'The Last Forty Years: Canada Since the Union of 1841'; 'The Story of the Upper Canada Rebellion').

Dent, Julia B. (1826–1902), wife of U. S. Grant W-92, G-132

Dental Corps, U. S. Army A-307*a*
- insignia U-178

Dental hygiene T-30

Dent corn, *picture* C-369

Dentils, in architecture, small blocks used as decoration in a cornice, *picture* A-259

Den'tine, tooth substance T-28, *picture* T-29

Dentistry D-54
- anesthetics A-196, 197
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- X-ray diagnosis X-200

Denton, Tex., city 35 mi. n.e. of Fort Worth; pop. 11,192; agricultural trade; Texas State College for Women, state teachers college.

D'Entrecasteaux Islands (*dän-trĕ-käs-tō'*), a group of islands in the Pacific Ocean off e. coast of New Guinea, belonging to British territory of Papua; gold has been discovered there; area, 1200 sq. mi.; *map* P-10*b*

Denver, James W. (1817–92), American general and frontiersman D-55

Denver, Colo., cap. and largest city; pop. 322,412: D-55, *map* C-310, *pictures* C-311, 313
- juvenile court J-232
- natural gas, pipe lines supply G-24

Denver, University of, at Denver, Colo.; founded 1864 by Methodist Episcopal church; liberal arts, law, commerce, science and engineering, art, librarianship; graduate school.

Denys, Nicholas (1598–1688), Canadian trader, born Tours, France; 1633–71 engaged in trade in Acadia; 1654–71 governor of the islands of the Gulf of St. Lawrence and of Newfoundland.

Deodar, or **"divine tree,"** a species of cedar (*Cedrus Deodara*) native to the Himalaya Mts., where it forms dense forests; reaches great proportions; wood in great demand for cabinet work.

Deodorant A-223

Department, a territorial division of France F-178–9

Department, in U. S. government. *See in Index* Agriculture, Department of, etc.

Department store, a store made up of many departments each of which is confined to one class of merchandise, such as dry goods, clothing, furniture
- chain stores C-137–137*a*
- development in U. S. H-228–9
- Munich, *picture* M-301
- pneumatic tubes P-264

DePaul University, Chicago, Ill.; Roman Catholic institution, founded

ü=French *u*, German *ü*; *ġ*em, *ġ*o; *th*in, *th*en; *ṅ*=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); *K*=German guttural *ch*

ü=French *u*, German ü; ġem, ḡo; *th*in, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); ᴋ=German guttural *ch*

Key—cāpe, ăt, fär, fȧst, what, fall; mē, yĕt, fērn, thêre; īce, bĭt; rōw, wón, fôr, nŏt, do; cūre, bŭt, rude, full, bûrn;

ü=French *u*, German ü; ġem, ḡo; thin, then; ṅ=French nasal (Jeaṅ); zh=French *j* (z in azure); ḵ=German guttural *ch*

Dover, Del., state cap., 35 mi. s. of Wilmington in fruit-growing region; pop. 5517; fruit canning and evaporating plants: D-40*d*, *map* D-40
capitol, *picture* D-40

Dover, England, port on English Channel; pop. 42,000: D-87, *map* E-270*a*
cable C-8
Caesar's landing E-270
harbor H-216

Dover, N.H., manufacturing city on Cocheco River 10 mi. n.w. of Portsmouth; pop. 14,990; textiles, shoes, woodworking machinery; oldest city in state (1623): *map* N-86

Dover, N.J., town 20 mi. w. of Paterson; pop. 10,491; varied manufactures: *map* N-90

Dover, Strait of, channel connecting North Sea with English Channel and separating England and France; 20 to 27 mi. wide; chalk cliffs on both sides: *maps* E-270*a*, F-179

"Doves, Letting Out the," game P-252, *picture* P-253

Doves Press, noted English printers
Bible, specimen page, *picture* B-181
bookbinding design, *picture* B-182

Dovre Mountains, or **Dovre Fjeld** (*dō-vrŭ fyĕld'*), range in cent. Norway; highest peak 7615 ft.: *map* N-173

Dow, Gerard. *See in Index* Douw, Gerard

Dow, Neal (1804–97), American temperance orator, born Portland, Me.; author of Maine prohibition law.

Dow'ager, a widow with a dower; especially designates widow of titled person to distinguish her from wife of her husband's heir who has same title, as queen dowager.

Dowden, Edward (1843–1913), British educator and literary critic; noted Shakespearean scholar; professor of English literature at University of Dublin, 1867 until death ('Shakespeare, His Mind and Art'; 'Poems'; 'Shakespeare Primer'; 'Life of Shelley').

Dower, in law, a forced share which the surviving spouse has by law in the estate of the deceased spouse. Originally, dower referred only to the share of the surviving wife; the share of the surviving husband was called curtesy.

Dow'ie, John Alexander (1848–1907), American religious leader, born Scotland; self-styled "Elijah the Restorer"; preached "faith healing"; founded Christian Catholic Church (1901) at Zion City, Ill.

Down, plumage F-20

Downes, Olin (born 1886), music critic, born Evanston, Ill.; on Boston *Post* 1906–24, afterwards on New York *Times*; lecturer and writer on musical theory, history, and appreciation ('The Lure of Music').

Downing Street, popular name for the British government; so called because both Foreign Office and the official residence of the prime minister are in Downing Street

Downs, system of chalk hills in s.e. England; North Downs in Surrey and Kent; South in Sussex; latter feeding ground for famous Southdown sheep.

Downs, in Australia P-200

Down under, a term used to designate the Antipodes—Australia, New Zealand, etc.; for example, the man from down under.

Downy woodpecker W-134, 135, *picture* W-134, *color plate* B-136

Dowry, the marriage portion M-69

Dowser. *See in Index* Divining rod

Dowson, Ernest (1867–1900), English poet; hypersensitive, ill with tuberculosis, and addicted to drugs and drink, lived lonely, unhappy life; best known for musical and delicate lyrics, most of which are colored with sadness and disappointment; most famous poem is 'Cynara'.

Doyle (*doil*), **Sir Arthur Conan** (1859–1930), British novelist, creator of famous detective character Sherlock Holmes. While practising as physician he began to write detective stories. He served as medical officer in Boer War and wrote two books defending the British position; during first World War wrote propaganda for Allies. Later he devoted himself almost exclusively to spiritualism ('A Study in Scarlet'; 'The Sign of the Four'; 'Adventures of Sherlock Holmes'; 'Sir Nigel'; 'Cause and Conduct of the World War').

Dracaena (*drȧ-sē'nȧ*), genus of perennial plants of lily family, native to the tropics. Used as foliage plants because of broad or sword-shaped, varicolored leaves. Dragon-tree (*D. draco*) of Canary Islands grows to 60 feet; its dried juice supposed to resemble dragon's blood.

Drachenfels (*drä'ĸĕn-fĕls*), "dragon's rock," mountain in Germany, 10 mi. s.e. of Bonn, 1065 ft. high; castle.

Drachma (*drăk'mȧ*), Greek monetary unit, worth about 2 cents; coined in nickel-copper; in ancient Greece, silver coin worth 9 to 17 cents.

Drachmann (*drăk'măn*), **Holger Henrik Herboldt** (1846–1908), Danish poet, dramatist, and short-story writer ('Tendrils and Roses'; 'Once upon a Time' and 'Wayland the Smith', plays; 'The Sacred Five', autobiographical work).

Draco (*drā'kō*) (7th century B.C.), compiler of first written code of Athenian laws G-157

Draft, military conscription. *See in Index* Conscription

Draft, negotiable instrument C-393

Draft animals. *See in Index* Transportation, *subhead* animal power

Draft riots, New York City (1863) N-134

Drag, of a speeding object
airplane A-80
streamlining overcomes, *pictures* A-81

Draga (Mme. Draga Mashin) (died 1903), queen of King Alexander I (Obrenovich) of Serbia; formerly lady in waiting to his mother, Queen Natalie; assassinated with the king by a political group which opposed the marriage.

"Drag freight" service R-45

Dragon, fabulous animal D-87–8
Cadmus kills C-11
Chinese and Japanese myths D-88, C-221*i*
Jason and A-282
St. George slays D-87–8
Siegfried and Fafnir S-141

Dragon, name applied to two kinds of lizard
flying dragon L-170, D-88
giant lizard of Komodo E-346

Dragon, a breed of domestic pigeons P-216

Dragon Boat Festival, in China C-220, H-322, *picture* C-221

Dragon-fly, darning needle, or horse-stinger D-88–90, *pictures* I-81, D-88, 89
fossils A-210

Dragon's blood, a reddish brown resin, used in engraving E-298, G-188

Dragon-tree. *See in Index* Dracaena

Dragoon bird. *See in Index* Umbrella-bird

Drags, position of riders driving a herd of cattle C-111

Drainage, household S-87, P-260
building problems B-266

Drainage, land I-148. *See also in Index* Irrigation and reclamation

Drainage Canal, Chicago C-189, C-69, M-155, *table* C-433
effect on Great Lakes C-189, G-150

Drain pipes, tile B-239

Drais (*drīs*), **Karl** (1785–1851), inventor of velocipede B-107

Drake, Edwin L. (1819–80), pioneer American oil producer, born Greenville, N.Y. P-145, 146

Drake, Sir Francis (1540?–96), explorer and privateer, first Englishman to circumnavigate the globe D-90–1
burns city of St. Augustine S-7
Cadiz victory D-91
California: route, *map* C-26
captures Cartagena C-306
expeditions to America A-145, H-248
San Juan, Puerto Rico P-311
Spanish Armada defeated A-300–1
voyages, *maps* M-27, A-143

Drake, Joseph Rodman (1795–1820), American poet, born New York City; often used signature "Croaker" ('The Culprit Fay'; 'The American Flag'); subject of Fitz-Greene Halleck's eulogy:
"Green be the turf above thee,
Friend of my better days;
None knew thee but to love thee,
None named thee but to praise."

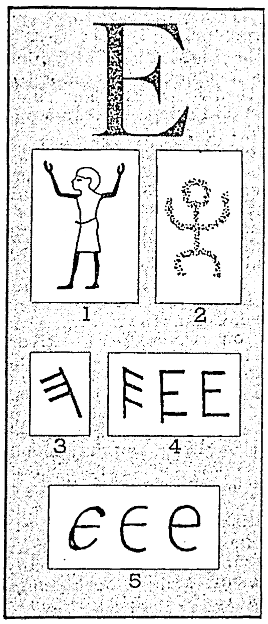
Drake, a male duck D-116

Drakensborg (*drä'kĕnz-bĕrĸ*), mountain range in s.e. Africa A-38, *map* A-42*b*

Drake University, at Des Moines, Iowa; opened 1881; departments include liberal arts, law, education, commerce, fine arts, Bible.

Drama D-91–9. *See also in Index* English literature; French literature; German literature; Motion pictures; Opera; Theater; also chief dramatists by name
American D-97, 98, 99
Chinese C-221*g*
Christmas plays and pageants, books C-230
comedy, origin of D-91–2
copyright C-362, B-191
Elizabethan S-99–100: Shakespeare S-94–100*h*, D-94
English D-93–6, 98, E-284
expressionism D-96, 97
French D-94, 96, 98, 99: Corneille, father of tragedy C-369–70; Hugo H-353; Molière's influence M-217
German G-63–4, D-94, 98: Passion Play B-65
Greek D-91–3, 98, G-172–3: forerunner of opera O-228; theaters T-74, 76
Ibsen's influence D-96, I-2
Irish I-132, D-96
Italian I-154, D-98
Japanese No drama J-191
medieval D-93–4: mysteries, miracle-plays, and moralities M-197
music drama M-314
naturalism D-96, 97
pageant P-11–12, *picture* D-95: movable stage, *picture* D-93
production of plays, books H-313*m–n*
puppets and marionettes P-368*a–d*, F-3, F-20
religion, relation to D-91, 93, G-172
Roman L-68, D-93

ü=French *u*, German ü; ġem, ġo; *th*in, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); ĸ=German guttural *ch*



OUR LETTER E probably started in Egyptian writing as a picture of a man with arms upraised (1). To the Egyptians this picture meant 'joy', or 'rejoice'. Soon after 2000 B.C., a Semitic people called the Seirites adopted it as an alphabetic sign for a sound like our 'h' in *hay.* They did this undoubtedly because their word for a cry of joy was 'hallel' (as in *hallelujah*, 'joy in the Lord'), and the little man made a good sign for the 'h' sound at the beginning of the word.

The Seiritic letter (2) was like the Egyptian picture; but the Canaanites and the Phoenicians simplified this sign to a group of strokes suited to writing from right to left (3). In Hebrew the sign was called *heh*, and other Semitic names were similar.

When the eastern or Ionic Greeks learned to write from the Phoenicians, they did not want a sign for 'h'. But they needed a sign for the vowel 'e', and it is easy to see why they thought of using the Semitic sign for 'h'. If the forceful 'h' sound is omitted from the beginning of 'heh', the sound 'eh' remains; and this is the short sound of the vowel 'e'.

The Greeks therefore adopted the *hallel* sign for their short 'e'. They called the letter *epsilon.* They also turned it around (4) for greater ease in writing from left to right. The Romans adopted this sign for the Latin capital E, and from Latin it came to us.

The handwriting of Graeco-Roman times changed the letter to a more quickly written form (5); and from this we got our printed and handwritten 'e'.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

ü=French *u*, German *ü*; ġem, ḡo; thin, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); ᴋ=German guttural *ch*

dustry, born Waterville, N.Y.; began as amateur; perfected process for making dry plates; invented kodak; developed rollable film; leader in business and philanthropic movements; gave millions to educational and welfare institutions
gifts for dental clinics P-162

Eastman, Joseph B. (born 1882), public official, born Katonah, N.Y.; member Interstate Commerce Commission; appointed director Office of Defense Transportation December 1941: N-12*h*

Eastman, Max (born 1883), American poet, essayist, and critic, born Canandaigua, N.Y.; taught philosophy at Columbia University; gave up teaching for study and writing on problems of economic equality; editor *The Masses*, a socialistic periodical ('The Enjoyment of Poetry'; 'The Colors of Life', poems; 'The Enjoyment of Laughter').

East Moline, Ill., manufacturing city on the Mississippi River, adjoining Moline; pop. 12,359; plows, harvesting and laundry machinery.

East North Central States, name used by U. S. government for geographic division: states of Ohio, Indiana, Illinois, Michigan, Wisconsin.

Easton, Pa., city on Delaware River at mouth of Lehigh, opposite Phillipsburg, N. J.; pop. 33,589; in cement, slate, steel and iron region; mining implements, railroad shops; Lafayette College: *map* P-112

East Orange, N.J., residential city 3 mi. w. of Newark and 12 mi. w. of New York City; pop. 68,945; machinery, electric motors; Upsala College, Panzer College of Physical Education and Hygiene: *map* N-90

East Point, Ga., residential and industrial suburb of Atlanta; pop. 12,403.

East Providence, R.I., manufacturing town on Seekonk River opposite Providence; pop. 32,165; oyster fisheries, baking powder plant.

East Prussia, easternmost province of Prussia, on Baltic Sea; 14,401 sq. mi.; pop. 2,256,000; cap. Königsberg: *map* G-66
1st World War W-155

East River, N.Y., strait separating Long Island from Manhattan Island, 15 mi. long N-123, 124, *map* N-130
piers, *picture* H-216

East St. Louis, Ill., railroad and manufacturing center on Mississippi River; pop. 75,609: I-18, *map* I-13

East South Central States, name used by U. S. government for geographic division: states of Kentucky, Tennessee, Alabama, Mississippi.

East Windsor, formerly **Ford City**, Ontario, Canada, former municipality (pop. 14,251), now part of City of Windsor, on Detroit River opposite Detroit, Mich.; automobiles.

Eating customs. *See in Index* Food, *subhead* eating customs

Eaton, Dorman Bridgman (1823–99), American lawyer and civic leader, born Hardwick, Vt.; wrote Pendleton Act for Civil Service reform; chairman Civil Service Commission 1873–75, 1883–86.

Eaton, Jeanette (born 1888?), author of children's books, born Columbus, Ohio; historical biographies: 'Young Lafayette'; 'Leader by Destiny' (George Washington).

Eaton, Theophilus (1591–1658), one of organizers of New England Confederation (1643); drew up code called "Connecticut Blue Laws"; early settler of New Haven.

Eaton, Walter Prichard (born 1878), American author, dramatic critic, and lecturer, born Malden, Mass.; professor of drama, Yale University; outdoor enthusiast ('Boy Scouts of Berkshire'; 'The Bird House Man'; 'Echoes and Realities', verse; 'On the Edge of the Wilderness'; 'The Actor's Heritage'; 'Ten Years of the Theater Guild').

Eau Claire (*ō clêr*), Wis., chief city in n.w. of state, 77 mi. e. of St. Paul, on Chippewa and Eau Claire rivers; pop. 30,745; tires and tubes, paper, packed and canned foods, boats; state teachers college: W-126, *map* W-124

Eau de Cologne (*ō dŭ kō-lōn'*), a perfume made of alcohol scented with aromatic oils; named from Cologne, Germany, where it originated.

Eave swallow. *See in Index* Cliff swallow

E'bal, Mount, in Palestine, opposite Mt. Gerizim; 3077 ft. high: P-33

Ebbinghaus (*ĕb'ing-hous*), **Hermann** (1850–1909), German psychologist; made detailed memory experiments, showing forgetting proceeds quickly at first then more slowly; established law that learning is direct result of number of repetitions.

Ebenezer (*ĕb-ē-nē'zẽr*) ("stone of help"), place in Judea where Samuel with divine help defeated Philistines (I Sam. vii, 10–12).

Eberle (*ĕb' ẽr-lē*), **Abastenia St. Leger** (1878–1942), sculptor, born Webster City, Ia.; studies of children and old women especially notable.

Ebers (*ā' bẽrs*), **Georg Moritz** (1837–98), German Egyptologist and novelist; professor at Jena and Leipzig; wrote historical romances with Egyptian settings ('An Egyptian Princess'; 'Uarda'; 'Homo Sum').

Ebert, Friedrich (1871–1925), German statesman, leader Social Democratic party and first president of the German Republic 1919–25: G-74

Eb'ony, tropical tree with black heart-wood E-143
Borneo B-197
resistance to heat F-46

Ebony fern, or ebony spleenwort F-24

Ebro (*ā'brō*), river of n.e. Spain; flows s.e. 465 mi. from Cantabrian Mts. to Mediterranean: *map* S-226

Ecbatana (*ĕk-băt'ȧ-nȧ*), Persia, ancient cap. of Media; summer residence, successively, of Median, Persian, and Parthian kings by whom it was captured and pillaged in turn; archeological excavations; modern name Hamadan.

Ecce Homo (*ĕk' sē hō' mō*) Latin, "Behold the Man," words of Pilate in showing Christ to the people (John xix, 5); favorite subject with old painters.

Eccentric (*ĕk-sĕn'trik*), of steam engine S-283

Eccentricity (*ĕk-sĕn-tris'i-tĭ*), in astronomy, measure of elongation of an ellipse; the ratio of the distance between foci to major axis
planets P-233

Ecclefechan (*ĕk-ĕl-fĕkh'ȧn*), village in Scotland, 14 mi. e. of Dumfries; birthplace of Carlyle.

Eccles, England, city on Manchester Ship Canal, 4 mi. w. of Manchester of which it forms suburb; cotton and gingham manufactures and engine works; famous for Eccles cakes; pop. 45,000.

Ecclesia, Athenian assembly D-45

Ecclesiastes (*ĕ-klē-zĭ-ăs'tēz*) ("the preacher"), a book of the Old Testament attributed by Jewish tradition to Solomon.

Ecclesias'ticus, one of the disputed books of the Old Testament B-104

Ecgbert. *See in Index* Egbert

Echegaray (*ā-chā-gä-rä'ē*), **José** (1833–1916), Spanish mathematician, statesman, and dramatist; shared Nobel prize in literature with Frédéric Mistral in 1904 ('Mariana'; 'The Great Galeoto'; 'The Son of Don Juan'): S-236

Echelon (*ĕsh'ĕ-lŏn*), in aviation, military formation in which planes fly as staggered units or groups below or above the leading plane or staggered sideways in a V-formation.

Echelon spectroscope S-242–3

Echeneis (*ĕk-ē-nē'is*), a fish, used in turtle catching T-167

Echeveria (*ĕk-ē-vē'ri-ȧ*), a genus of perennial plants of the orpine family, native chiefly to Mexico. The fleshy, often hairy, many-colored leaves are covered by white powdery material; used as foliage plants.

Echidna (*ē-kĭd'nȧ*), or **spiny anteater**, Australian mammal related to duckbill D-119, *picture* A-372

Echinacea (*ĕk-ĭ-nā'sē-ȧ*), a genus of perennial plants of the composite family, similar to the rudbeckias. Tall; leaves rough; flowers daisy-like, pink, rose, purple; also called purple coneflower; native to North America; roots source of an oleoresin.

Echinodermata, or echinoderms (*ē-kī'nō-dẽrmz*), a phylum of marine invertebrates, including starfish, sea-urchins, and sea-cucumbers Z-227, A-199, S-67, S-276–7

Echinops (*ĕk'ĭ-nŏps*). *See in Index* Globe thistle

Echium (*ĕk'ĭ-ŭm*). *See in Index* Vipersbugloss

Echmiadzin (*ĕch-mĭ-ȧ-dzēn*), U.S.S.R., district in Armenia famous for monastery, seat of Armenian church; 12 mi. w. of Erivan.

Echo (*ĕk'ō*), in mythology E-143, *picture* E-144

Echo, a reflected sound E-143–4
buildings, how avoided in S-196
how produced, *diagram* S-195
ocean depths found by S-196
radio: prevention R-29; in radar system R-24, *picture* R-25

Echo organ O-250

Echo River, in Mammoth Cave, Ky., *picture* C-117

Eck, John (Johann Maier von Eck) (1486–1543), German theologian, born at Eck, Swabia; opponent of Luther and the Reformation; defeated Luther in debate at Leipzig 1519; in 1520 obtained from Rome bull of excommunication against Luther; at Diet of Augsburg (1530) among those selected to refute Luther's theory of confession.

Eckener (*ĕk'ĕ-nẽr*), **Hugo** (born 1868), German airship builder, president of Zeppelin Construction Works; born Flensburg, n. Germany; associate and successor of Count Zeppelin; commanded the *Graf Zeppelin* on world trip 1929.

Eck'ermann, Johann Peter (1792–1854), German writer, friend and literary executor of Goethe ('Conversations with Goethe').

Eckhardt (*ĕk'härt*), or **Eckhart**, "the Faithful," old man in German legend who warned of evils those who followed Frau Holle or Holde (Venus); sometimes companion of Tannhäuser.

A LIST OF TERMS COMMONLY USED IN ECONOMICS AND BUSINESS

Acceptor. One who agrees to pay a check, draft, or other written order.

Accommodation paper. A draft or note given without value received.

Accounts payable. Money due to creditors for which no note, bond, or evidence of indebtedness was given; in bookkeeping, accounts payable appear on credit, or "liabilities," side.

Accounts receivable. Money which is due from customers and other debtors; the opposite of accounts payable.

Accrued dividend. Dividend accumulated, but not paid, since the last dividend payment; preferred stocks are often sold "plus accrued dividend," which means that the accrued dividend is added to the price.

Accrued interest. Amount accumulated on bonds and other evidences of indebtedness, since the preceding interest date; bonds and notes are always sold "plus accrued interest," except when interest is in default, when they are sold "flat" (without interest).

Ad valorem. A tax levied according to value; particularly customs duties, expressed in per cent.

Amortization. The liquidation or reduction of debt through a fixed scale of payments; usually a sinking fund; also the process of writing off each year the premium above par or discount below par, so that the payment at maturity will not show either a loss or profit.

Ancillary receiver. An agent or subordinate receiver, appointed by the court if property is involved in a state other than the one in which the defendant resides or has his principal place of business.

Assumed bonds. Bonds issued by one company, and later assumed or guaranteed by another; assumed bonds rank as a general obligation equally with other bonds of the assuming company. The purchase of equity does not obligate the buyer to assume the bonds.

Audit. Examination of records usually by independent bookkeepers, to show that the accounts are correct.

Balance of trade. Difference between the value of exports and imports.

Bear. One who believes that prices of commodities or securities will go down; he may work to that end either by selling securities he actually owns or by "selling short"; term is supposed to come from the bear's practise of holding down his victim; opposite of "bull."

Bonus. Amount given in addition to regular salary or wages; it may be fixed arbitrarily or in relation to the employer's profits.

Books closed. Time when stock transfer books of a business are closed to permit checking of stockholders to whom dividends are due; a corporation cannot transfer stock from one holder to another while the books are closed.

Book value. The net worth of a business or stock as indicated by the company's books; book value may be either greater or less than par value or market value.

Bucket shop. Popular name for a broker who does not actually buy and sell securities, for which the customer pays, but in effect bets with the customer on the course of future prices; bucket shops are forbidden by law in most states.

Bull. One who buys commodities or securities in expectation that they will advance in price; term is supposed to come from the bull's method of attack, which is to toss upward on his horns; the opposite of "bear."

Carrying charges. Interest charged by brokers for money advanced to carry accounts of their customers for whom they have bought securities on margin.

Closed mortgage. One against which no additional bonds of equal lien can be issued; additional bonds may be issued but they will have only a junior claim to the property.

Commercial agencies. Organizations which obtain the financial standing of individuals and firms and furnish this information to their subscribers.

Commission house. An agency which buys and sells for others on a fee or percentage basis, without assuming any liability for prices.

Convertible bonds. Those which the holder may exchange for some other form of security issued by the borrowing corporation; usually the new security to be received is junior in lien but higher in yield than the original bond.

Corner. The condition of the market when the available supply of a commodity or a security has been concentrated; a corner is the ultimate result of bullish operations.

Coupon. A certificate attached to a bond or mortgage, and specifying the amount of interest payable and the date and place of payment; when interest is due the holder of the bond detaches the coupon and collects the money, usually through a bank which acts as paying agent.

Coupon bond. One to which interest coupons are attached; coupon bonds are payable at maturity to the holder. Ownership at any time passes by delivery from a bona fide holder to a new buyer.

Current assets. Possessions such as cash and inventory, which can be converted into cash without depreciation in value.

Current liabilities. Obligations which are payable in a short time, usually not over twelve months; distinguished from funded obligations or funded debt.

Debenture. An evidence of debt resembling a bond in form but differing from it in its lien; in practise a debenture is a general obligation, merely an unsecured promise to pay, whereas a bond is secured by a mortgage on specified property.

Demurrage. Compensation charged by a railroad or other shipping agency for delay in releasing a freight, a vessel, or other conveyance.

Depreciation. Decrease in the value of assets, due to wear and tear of equipment, to decline in market price, or other causes; depreciation is a loss recognized on the company's books while the assets are still retained.

Due bill. A written acknowledgment of indebtedness; merchandise certificates issued by many stores are forms of due bills.

Earnest money. Part of the purchase price, paid by the buyer to the seller, for the purpose of binding the contract.

Excess profit tax. A federal tax levied against the net incomes of the individuals, partnerships, and corporations in excess of certain exemptions; in the United States the law which was in effect in 1921 used as a basis for this tax the relation between net income and invested capital.

Ex-dividend. Meaning "without dividend." Dividends are declared due to stockholders of record on a specified date. Between the record date and the date on which the dividend is payable, the stock is sold "ex-dividend," the dividend accruing to the seller and not to the buyer.

Fiat money. Paper money which is not based on gold or other specie, but is made legal tender by government order or "fiat"; examples are United States "green back" and French paper money (assignats).

Firm. The term used in grain and stock exchanges to describe binding options granted by a seller to a prospective seller; when a security is offered "firm" the seller obligates himself to deliver the amount specified at the agreed price.

Fiscal year. The twelve months' period for which the accounts of a business or government are figured; in United States the government's fiscal year ends June 30.

Fixed charges. Interest on debt, sinking funds, sometimes rentals and similar items which cannot be reduced, as distinguished from dividends which may be changed by a corporation at its discretion.

F. O. B. (free on board). The price quoted includes all charges up to the time and place of shipment; it does not include freight and delivery charges.

Free trade. The policy of admitting imports without payment of customs duties.

Funding. The conversion of current liabilities into long-term obligations.

Futures. Securities or commodities sold or bought with the assumption of delivery at a later date.

Hedging. A purchase or sale, as an offset to a possible loss; for example, a short sale of wheat by a miller to offset a possible loss in inventory value of flour in storage.

Holding company. A company which owns securities of one or more other companies and is in a position to control or influence the management of these companies.

Interim certificates, or interim receipts. Promises issued by a banker or a trustee to deliver bonds or other securities when they are ready for distribution; they are exchangeable for permanent certificates or bonds without cost to the holder.

Interlocking directorates. When one or more directors are also directors of other corporations the directorates of such corporations are said to be interlocking.

Inventory. A report or statement listing the merchandise on hand and other assets of a business.

Invoice. A statement sent to a purchaser listing the item or items bought and their purchase price.

Joint stock company. A partnership whose funds or capital are divided into shares.

Laissez-faire (Let alone). The doctrine that it is best to let economic forces, particularly competitive effort, work out their results without governmental interference or control.

A LIST OF TERMS COMMONLY USED IN ECONOMICS AND BUSINESS—*Continued*

Limited liability company. A partnership whose liability is limited to its stated capital, distinguished from the ordinary partnership where all the property of the partners may be seized for the debts of the partnership; usually indicated by the abbreviation "Ltd."

Most favored nation. With reference to customs duties; special low rates applied to imports from the favored nation, usually in return for similar treatment (reciprocity).

Open mortgage. Unlimited as to the amount; in practise an open mortgage permits the issue of additional bonds or notes provided the total debt and the interest charges continue to maintain a specified ratio to the property value and the net earnings respectively.

Option. The privilege of buying or selling some specified property or commodity at a given price within a stated time; to be legally binding an option must state a consideration.

Preference shares, or preferred stocks. Shares bearing a stated fixed dividend which must be paid out of earnings before common stock dividends are declared; ordinarily they are non-voting shares.

Protection. The policy of promoting home industry by imposing import taxes on foreign products.

Proxy. A person who is authorized to act for another; also the document conferring this authority.

Put and call. A special form of option, in stock and grain trading; the seller of a "put" has obligated himself to accept within a specified time (usually 30 days) a fixed amount at a stated price; the seller of a "call," on the contrary gives the buyer the right to call on him for delivery of the stock or grain at the price fixed.

Pyramiding. To buy or sell in business transactions, using indicated paper profits as the basis or margin for subsequent transactions.

Receiver. A person or firm appointed by a court to manage the property or assets of another while adjustment of debt is being made according to statute.

Reciprocity. A mutual giving and taking, particularly the grant of special tariff rates to a country in return for similar favors.

Rediscounting. The process by which a bank borrows from a central bank or banking system, such as the Federal Reserve Banks, using as collateral for the loan notes and the obligations which it has discounted for its customers; the interest which the central bank charges is called the "rediscount rate."

Refunding. The replacement of an old loan by a new one, as a refunding bond.

Registered bond. One whose ownership is recorded with the corporation issuing it; unlike a coupon bond, a registered bond is transferable only by indorsement and by subsequent registration on the records.

Rent. The payment made for the use of property, fixed or movable, such as real estate or machinery.

Reserves. Profits set aside, in the operation of a business, to meet possible future losses or contingent expenses; dividends in poor years may be paid out of reserves set aside in earlier good years.

Rights. The privilege to subscribe, usually to stocks and bonds, at a price which makes the privilege valuable; example: a stockholder buys one new share of stock at $100 for each ten shares he already owns; the old stock is selling at $200; the "rights" will then be worth $9.00, or 1/11 of the difference between the market price and the subscription price.

Sales tax. Tax levied by many state governments on sales of merchandise or commodities; usually commodities subject to state excise tax, such as gasoline and liquor, are exempted.

Scalper. One who buys and sells for a quick profit, often without making a substantial investment.

Scrip. A certificate issued as evidence of an obligation; corporations issue scrip principally in lieu of fractional shares or of cash dividends when they wish to continue dividends while still holding their cash.

Secured creditor. One who has property pledged to secure the payment of debt.

Shareholder, or stockholder. One who owns shares in a corporation or limited liability company. A shareholder is not liable for corporate debt. Till the Federal Banking Act of 1935 (effective July 1, 1937) national bank stockholders were excepted. They were liable for an additional amount equal to par value of their stock; this was "double liability."

Short selling. A sale made in anticipation of a decline in price, by a seller who does not own the securities or commodities sold. The seller (or his broker) may agree to deliver the securities or commodities to the buyer at some future date or may obtain them on credit for immediate delivery. In either case he expects to profit by buying the securities or commodities needed to meet his future obligations at a lower price than he received when he made the "short" sale. If he is compelled to "buy in" at a higher price, he is said to be "caught short" and suffers a corresponding loss.

Sinking fund. Money set aside out of earnings, at stated intervals, for the purpose of reducing funded debt.

Speculation. Trade in securities or other commodities for the purpose of making a profit, distinguished from investment which is purchased for the purpose of obtaining income.

Surplus. The excess of assets over liabilities, or the total of profits which has not been distributed or reserved for special needs.

Syndicate. An association of capital to obtain a definite objective; especially a combination of financiers to buy an issue of securities and distribute it by sale to the public.

Underwriter. One who insures another on life, health, or personal property in a policy of insurance.

Valorization. Maintenance of a commodity's price by governmental control; the best example is the Brazilian government's control of the price of coffee.

Vital statistics. Public records kept by a state, city, or other governmental subdivision, under a statutory provision, of births, marriages, deaths, and disease.

Wash sales. A fictitious sale, correct in form, but made without intention to deliver goods; in stock market operations wash sales are made by the seller to his agent, or to himself under another name.

Wealth. Distinguished from riches, is anything which has the power to satisfy wants, and which cannot be obtained without effort.

ü=French *u*, German *ü*; *ġ*em, *ġ*o; *th*in, *th*en; *ṅ*=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); *K*=German guttural *ch*

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